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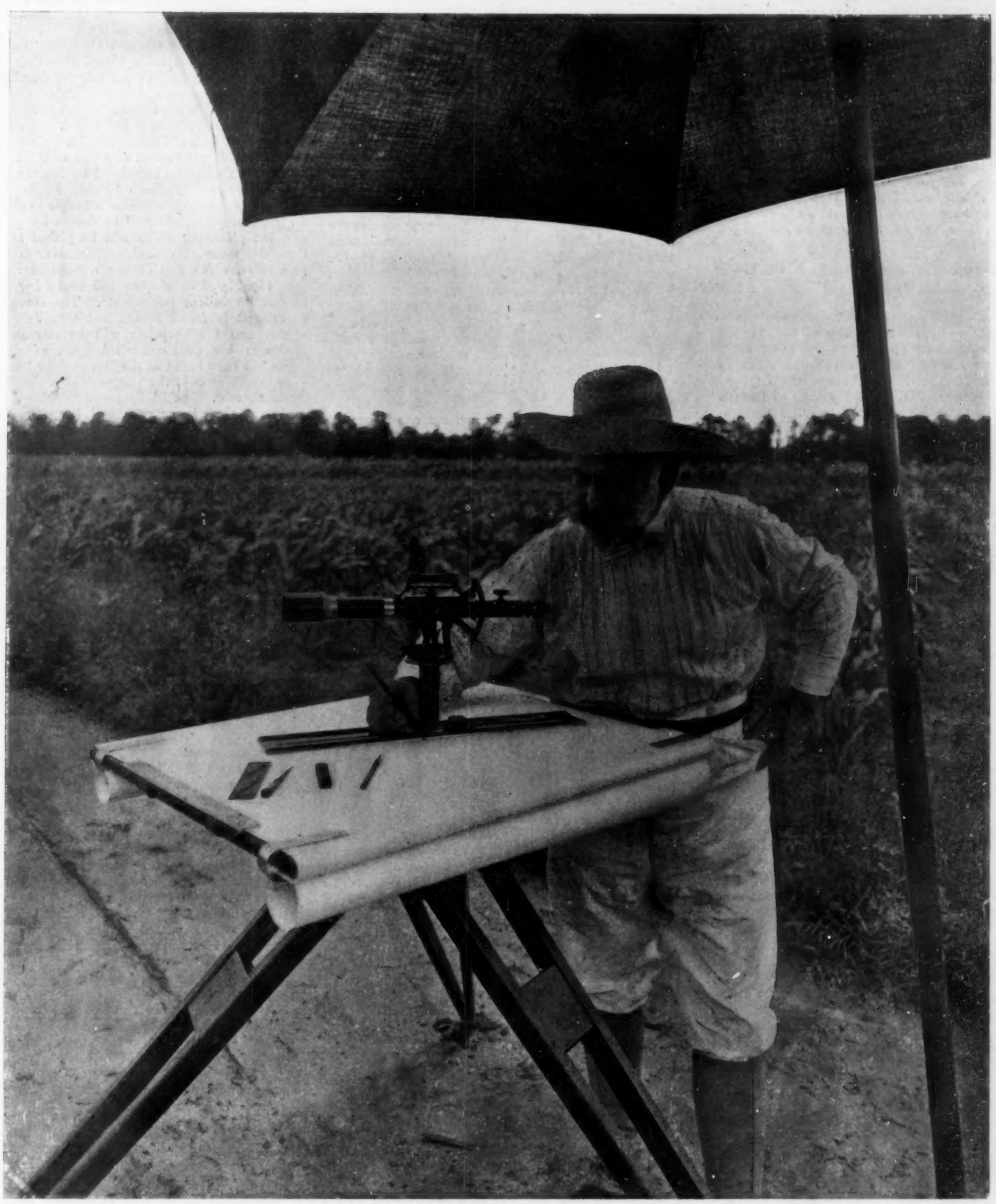

Plane table and alidade as used in drawing a map directly from nature.

MAKING A MAP ON THE SPOT.—[See page 400.]

SCIENTIFIC AMERICAN

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately and in simple terms, the world's progress in scientific knowledge and industrial achievement. It seeks to present this information in a form so readable and readily understood, as to set forth and emphasize the inherent charm and fascination of science.

The Rewards and Penalties of Polar Exploration

IN its last issue, our esteemed contemporary, *The Navy*, publishes a map of the North Pole region, on which is plotted the exact route, as shown by his note books, along which Peary approached the pole. The map was drawn and Peary's route plotted by two experts of the United States Coast and Geodetic Survey, working independently, and their calculations agree within a second of latitude. Mr. Mitchell, one of the experts, states that from his professional experience, it would have been impossible for the observations set down in the note book to have been obtained except under the circumstances claimed. There was a slight error in Peary's chronometer, which threw him a little to the left of the Pole, which he reached by a detour to the right, that brought him within 1.6 miles of the exact center. The naval committee reports that this very error in the chronometer proves the truth of Peary's position and the correctness of his observations.

As the result of this report, our great explorer has received an altogether too tardy national recognition by being advanced to the grade of Rear Admiral. It is surely a strange anomaly that the attempt to rob Peary of his honors by one of the most stupendous lies of history should have so far succeeded that his own country has given him adequate official recognition, only after the scientific societies of the world had presented him with eighteen medals and honorary degrees, and had agreed, according to the language of the report, "in pronouncing this the greatest geographical prize of the last three centuries." Elsewhere in the present issue, we publish the map showing Peary's exact position as plotted by the Coast and Geodetic Survey from Peary's note books. It should be observed that to come within a mile and a half of the mathematical pole was a very close result. As the committee says, "it is a well recognized fact that exact results are not obtainable as the result of observations. A matter of one or two miles, under favorable circumstances, is a fair allowance."

So much for the rewards of polar exploration—of the penalties—physical, mental, and, last and not least, political, the greatest polar explorer of all time has surely more than had his share. There are few conditions that are more exasperating to the professional man than to be baited and hectored by a layman whose professional knowledge is in the inverse ratio of his zeal and volubility. Never did Admiral Peary show finer self-restraint than when he was being subjected to cross-examination before committee by the Hon. Mr. Macon, of Arkansas. Mr. Macon evidently entered the lists against Admiral Peary, armed cap-a-pie. Not alone was he arrayed in all the panoply of longitude, latitude, declination and azimuth, but he could swing right deftly the battle-axe of gravitation and poise with unerring aim the keen lance of centrifugal force. Does the gentle reader doubt our statement? Let him read the following question of the honorable gentleman from Arkansas, as launched against Peary in the hearing above mentioned:

Mr. Macon: "For the reason that the diminishing centrifugal action, and, in proportion, the increasing center of gravity near the pole causes a complete failure of man and animal energy that produces a kind of paralysis of the senses and of motion, a paralysis of sensation in any part of the body, including the exercise of the faculty of the mind. Do you know anything about that contention on the part of scientists? . . . So that it would be almost impossible for them to exercise their independent functions so that anybody could ascertain a real fact—intelligently ascertain a fact?"

Peary answered: "I have never heard of that before."

We have to confess that we have never heard of it ourselves.

Multiple Engines for Passenger-carrying Aeroplanes

IN selecting the element of engine reliability as the basis for his handsome offer of $15,000 for the multiple-motor aeroplane showing the greatest all-round efficiency, Mr. Edwin Gould displayed a discrimination upon which the events of the past few weeks have laid strong emphasis. We refer to the fact that the feats of Blériot and Bréguet in carrying respectively nine and eleven passengers have proved that, at least in the domain of sport, trips in a single aeroplane by large parties of people are pretty sure to become a popular form of amusement. When that time arrives, and if we are not mistaken it is coming very quickly, the question of making the aeroplane of large carrying capacity perfectly reliable and safe becomes very important indeed. From the moment an aerial "bus" leaves the ground with its precious load of a dozen or more people, to the moment when it returns to its chosen landing place, there must be no question whatever of the failure of the motive power; and it seems to us that the only way to gain this assurance is to divide the power between two or more separate and absolutely independent units. It is possible, of course, to assign too much importance to the recent passenger-carrying feats in France. In one case, at least, the crowd was made up of boys, and in the other the flight consisted of not much more than a short jump at a slight distance above the ground. But the suggestion is there; and we may be sure that the promoter, with an eye to gate receipts and profits, will not fail to take note of the money-making possibilities presented by aeroplanes carrying from a dozen to twenty people beset by a crowd of the curious and adventurous, clamoring for the privilege of a ride through the air at anywhere from ten to twenty dollars per head.

At first, these trips will be confined to straight-away or circular flights within the boundaries of smooth and unobstructed aviation grounds or race-track fields; but it will not be long before the alluring prospects of big profits to the promoter will lead to more ambitious flights across the country.

Now for aeroplanes of magnitude, carrying many passengers, the motive power must necessarily be very large, and its division into two or three units will become a convenience, and for reasons of safety, a necessity. The considerations which have led to the use of twin-screws on steamships apply with even greater force to the navigation of the air. The disablement of the steamship motive power may lead to inconvenience; but the breakdown of the aeroplane motor, when the machine is loaded with passengers, might readily mean an appalling catastrophy.

The importance, then, of the forthcoming competition for the Gould prize is evident. Just now aviation is a sport pure and simple. So, in its earlier stages was the automobile, which to-day has settled down to its permanent place as one of the most important of our means of everyday transportation. Ultimately, and before very long, the aeroplane, whose development has been far more rapid than that of the automobile, will settle down into its proper place in the economic world. When that condition is reached we believe that the question of the reliability of the motive power will be recognized as absolutely pre-eminent; and one of the most important problems bearing upon reliability will be that of the most effective way of sub-dividing the motive power so as to obtain the maximum efficiency from motors and propellers, both when they are running independently and when they are coupled up for maximum power.

Progress in Motor-driven Steamships

IT is probable that few people in the United States have any idea of the rapid progress which is being made in Europe in the application of the internal combustion engine as the motive power of ocean-going steamships. Already a freight steamer of over 1,000 tons, carrying this type of motive power, is afloat and in successful operation, and several others, ranging from about this size up to the big 9,000-ton steamer under construction for the Hamburg-American line, are being built and within less than twelve months' time will probably be in service.

The credit for being the first to set afloat a ship of deep-sea size equipped with internal combustion engines is due to the Dutch, and the "Vulcanus," of 1,179 tons gross measurement, will probably be quoted by the historians as having led the way in this most important field. The "Vulcanus" is driven by a 6-cylinder Diesel reversing engine, which, at 180 revolutions per minute, develops 600 indicated horse-power. The consumption is stated to be about 2½ tons of crude fuel oil per day when the ship is being driven at full speed.

Then there is the "Holzapfel-I," a freight steamer capable of carrying about 300 tons of dead weight, which will shortly be completed by Messrs. Eltingham & Company at South Shields, England. For two reasons, particular interest attaches to this craft. In the first place, she will be driven by producer-gas, the plant for which will be placed in a gas-tight compartment entirely separate from the engine room, which will contain a 6-cylinder gas engine capable of developing 180 brake horse-power at 450 revolutions per minute. The second point of interest is found in the fact that between the engine and the propeller will be introduced the Föttinger hydraulic reduction gear, of which so much has been heard in the last year or two. This gear serves at once the purposes of a clutch and a speed reducer.

A much more important vessel, in point of size, is the ship recently laid down in Great Britain for the Russian East Asiatic Steamship Company. This vessel, whose tonnage will be 5,000, will be driven at a speed of 12 knots by two 8-cylinder Diesel oil engines. An interesting feature is the fact that the auxiliary work of lighting, driving the steering gear, and performing other auxiliary duties, will be done by oil engine units of small size.

The most notable internal combustion vessel for the merchant service is that which is now being built in Germany for the trans-Atlantic service of the Hamburg-American line. This vessel of 9,000 tons will be driven by twin engines, each of 1,500 horse-power, and it is expected that she will develop a speed of 11 to 12 knots. The Hamburg-American ship will probably make her maiden voyage in the spring of next year, and the ship for the Russian Steamship Company should be in service early in 1913.

It is not often that so bold a step is taken thus early in the process of entirely changing the motive power in any field as important as that of the ocean-going marine engine, and the greatest credit is due to the two steamship companies above mentioned for the enterprising faith with which they have placed the orders for these two large vessels. Within a year and a half from the present writing, the question of the substitution of the internal combustion for the steam engine on ocean steamships of large size will be fairly well settled. Whether the engine builders will by that time be prepared to make such an advance as occurred when Parsons placed the steam turbine in the then unprecedented "Lusitania" and "Mauretania," remains to be seen. It is our belief that progress from 3,000 horse-power to 60,000 or 80,000 horse-power will be made by more gradual increments than occurred in the introduction of the steam turbine.

Meanwhile, we must not forget that both the British and German navies are making experiments on a big scale in the introduction of internal combustion motors on warships of large size. Just what the British admiralty is doing we cannot say; but we understand that the Germans are building three units of the Diesel type, each of 6,000 horse-power. One of these is to be given a lengthy and severe shop test; and if the results are satisfactory, the three engines are to be installed in a fast cruiser in which the power will be developed on three separate shafts. If the 18,000 horse-power cruiser proves to be a success, the next step will probably be to a four-shaft vessel of 40,000 horse-power or over.

G. Stanley Hall

An American Leader in the Science of Human Nature and Its Education

By Edward L. Thorndike, Professor of Educational Psychology in Teachers College, Columbia University

G. STANLEY HALL has been for nearly twenty years the prophet and promoter of the doctrine that human intellect and character can be understood and educated only in the light of their evolution in the race. He early became fascinated by the fact that the mind of man has developed from the mind of the lower animals, and that its present make-up and future possibilities depend upon its history for perhaps millions of years past. In season and out of season, to teachers and parents, as well as to his fellow psychologists, he has preached that the history of mental development in the animal kingdom as a whole is the key to the growth of each child's mind.

To this doctrine, which is now accepted as a matter of course by philosophers and theologians, as well as biologists and psychologists, he added three others, which captivated the imaginations of many of his followers. The first is that the growth of a human being's "soul," that is, his intellect and character, from the beginning of life to manhood, parallels or recapitulates the development of intellect and character in the animal kingdom, so that the child's mind is at one stage like that of a worm, at a later stage like that of a fish, later like that of a monkey, later like that of a savage, and only after many years like that of modern men. "Stage by stage," he writes, "we enact their lives." "The child and the race are each keys to the other."

The second doctrine is that "Nature is Right," that a child *ought* to pass through just this series of stages, that the process of inner growth should be left to take its course, uninterfered with by our artificial ideas of what children ought to be and do and become. "Along with the sense of the immense importance of further co-ordinating childhood and youth with the development of the race has grown the conviction that only here can we hope to find true norm against the tendencies to precocity in home, school, church, and civilization generally, and also to establish criteria by which to diagnose and measure arrest and retardation of the individual and the race."

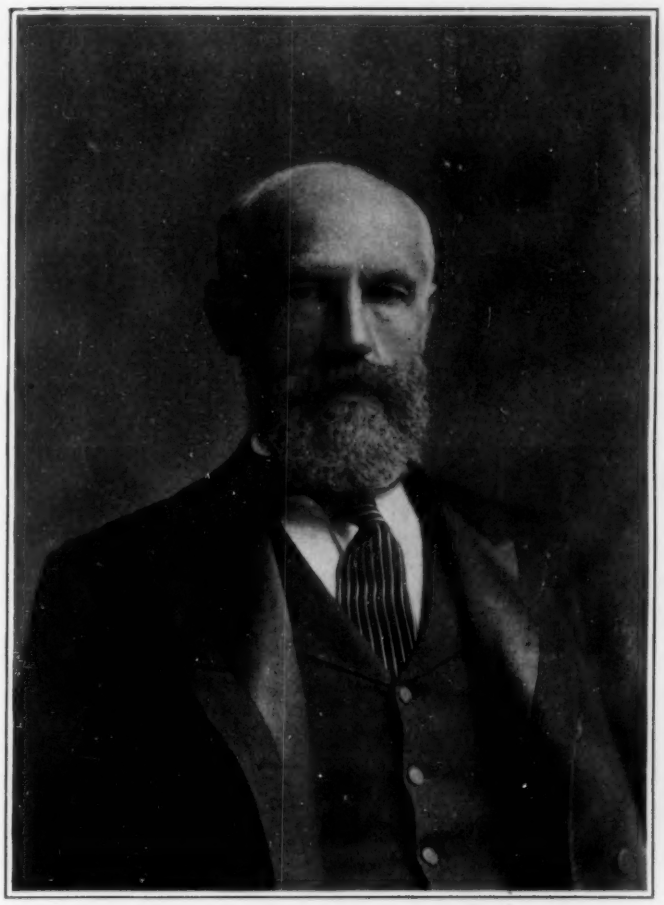
Since many features of the natural untutored behavior of children, such as grabbing whatever they want, fighting whoever tries to take it from them, teasing, bullying, cruelty to animals, laziness and envy, are intrinsically detestable and so seem to prove that nature is abominably wrong, President Hall devised the third doctrine, that certain childish tendencies which, in and of themselves, would be pernicious, are, nevertheless, desirable, because only by their exercise in childhood can one avoid a worse fate later. That is, by having cruelty in a mild form at six, one is preventively inoculated against being a Nero at sixty. By being a bully in childhood one purges his soul from domineering in adult life. The deplorable tendency of adult financiers would have been driven out of their systems, had they been left free in the nursery to take whatever they wished, and bite, scratch, or otherwise inflict upon protesting playmates whatever the market would bear!

These three doctrines are, of course, somewhat misrepresented in so brief and bald a statement. Full quotations from President Hall's writings would show them in a more tempered form with compromises toward the opposite doctrines—that a child's mind is made into an adult's mind in the easiest way that nature has hit upon; that the original nature of man is very wrong in spots, and that indulging a bad tendency in childhood helps to form the bad habit for good and all.

Partly in the interest of these theories and partly from a pure scientific curiosity, President Hall and his pupils at Clark University have turned from the older topics of mental science—from questions about how man perceives, how he remembers, how he reasons, what imagination is, what attention involves, and the like—to questions of what concrete, particular acts and thoughts men, women and children manifest in the actual, gross situations which life offers. He has tried to find out how children think and feel and act toward water, trees, clouds, dogs, cats, dolls, money, games, home, teacher, society, solitude. He has amassed long lists of what situations call forth the responses of fear, pity, anger, and the like. He has canvassed history, biography and literature for evidence about what concrete human nature really is and how it behaves.

Thousands of printed questions have been sent out broadcast—a modern inquisition ranging from "What effect has a new overcoat, high hat, high heels . . . upon the self confidence, self assertiveness and personality of the owner?" to "What force and motive led you to seek a higher and a better life?" and from "What do you know of beggars?" to "Have liberalizing theological opinions made you better or worse, and how?"

It is now generally admitted that the difficulties of transmuting the testimony of untrained observers given in response to such questions into a science of human nature are well nigh insurmountable, and that the practice of issuing these so-called *Questionnaires* without elaborate cross-examination and objective verification is undesirable. But for the fundamental motive that prompted them, the desire to make psychology a science as broad as human nature itself, there can be only praise. President Hall was an early leader in making phychology the science of total human nature, and in showing what work it had to do in explaining the actual behavior of men in work, play, health, disease, crime, religion, and every activity of life.



G. STANLEY HALL

Granville Stanley Hall was born at Ashfield, Massachusetts, sixty-five years ago, was educated at Williams College, Union Theological Seminary, Harvard, and abroad. He was one of the eminent group composing the faculty of Johns Hopkins University. In 1889 he organized Clark University, of which he has since then been president.

President Hall's writings, published in the main in the *American Journal of Psychology and Pedagogical Seminary*, make a very long list, over two hundred, comprising perhaps five thousand pages. He is the editor of the *Journal of Religious Psychology* and the *Journal of Race Development*. He is now putting together the results of a life of enormous activity in collecting facts about human nature and behavior in the three final works—one on psychology in general, one on Adolescence and its Relations to Physiology, Anthropology, Sociology, Sex, Crime, Religion and Education, and one on Educational Theory and Practice. Of these the second was published in 1904. The volume on Educational Problems has recently been published.

A large work of his on the Psychology of Feelings is approaching completion. He also has in hand books to be entitled "The Psychology of Jesus and of Religion Generally" and "Genetic Psychology."

The Jumping Bean

THAT extraordinary product of the vegetable kingdom, the "jumping bean," is derived from a bush, closely resembling the coffee bush, that grows in the Yaqui River country of western and northern Mexico. The bush attains a height of from three to four feet, and the hundreds of blossoms that it puts forth are of an olive-green tint which, after ripening, turns to a buff gray. Within each blossom are two "fertile" seeds, and a third, which is the home of a small, exceedingly active worm, whose performances are responsible for the queer conduct of the bean. When this worm emerges from its prison it becomes a beautifully colored moth.

The seeds of the jumping bean blossom in the month of May. Then the female moth deposits one egg on the pollen of the flower. As the flower develops it forms a triangular-shaped shell on two sides, with a convex shape on the other. Within this the chrysalis develops into a grayish-brown worm about one-tenth of an inch in diameter and about half an inch in length. This worm lives inside its cell for a period of six months, or until the middle of November. Then, climatic conditions being favorable, it bores a hole through the end of its shell and flies away as a moth, to mate in its turn and perpetuate the species.

If, however, it is brought in the bean to a colder climate the worm will die in the shell. Cut a small hole in the end of a jumping bean about an eight of an inch in diameter, and in less than one hour the worm will cover the break with a white fiber-like exudation from its stomach, working the mouth round the opening until the hole in the shell shall become completely closed.

Kept in a moderately warm place, and not packed too tightly, the jumping beans will live for five or six months to mystify and amuse. The jumping is caused by the worm's curling itself into a ball and then springing out to full length against the side of the shell, thus making the bean jump from the hand into the air.

Journalistic Colors

WHILE the use of colored paper by American journals is usually confined to the magazine and sporting supplements, in other countries, particularly England, colored paper seems to be a kind of journalistic trade mark. There is the *Westminister Gazette*, which, by reason of the color of its pages, has been called "the sea-green incorruptible." The old-fashioned Tory organ, the *Globe*, offers a deep pink, as does its contemporary, the *Sporting Times*, with greater reason. The *Winning Post* shows a nice, pale orange.

The stock of paper in the island of Trinidad becoming exhausted, the Port of Spain *Gazette* for a time appeared on a mauve colored paper, together with a bright yellow inside supplement. Later it showed for several issues cerise paper, with a magenta supplement.

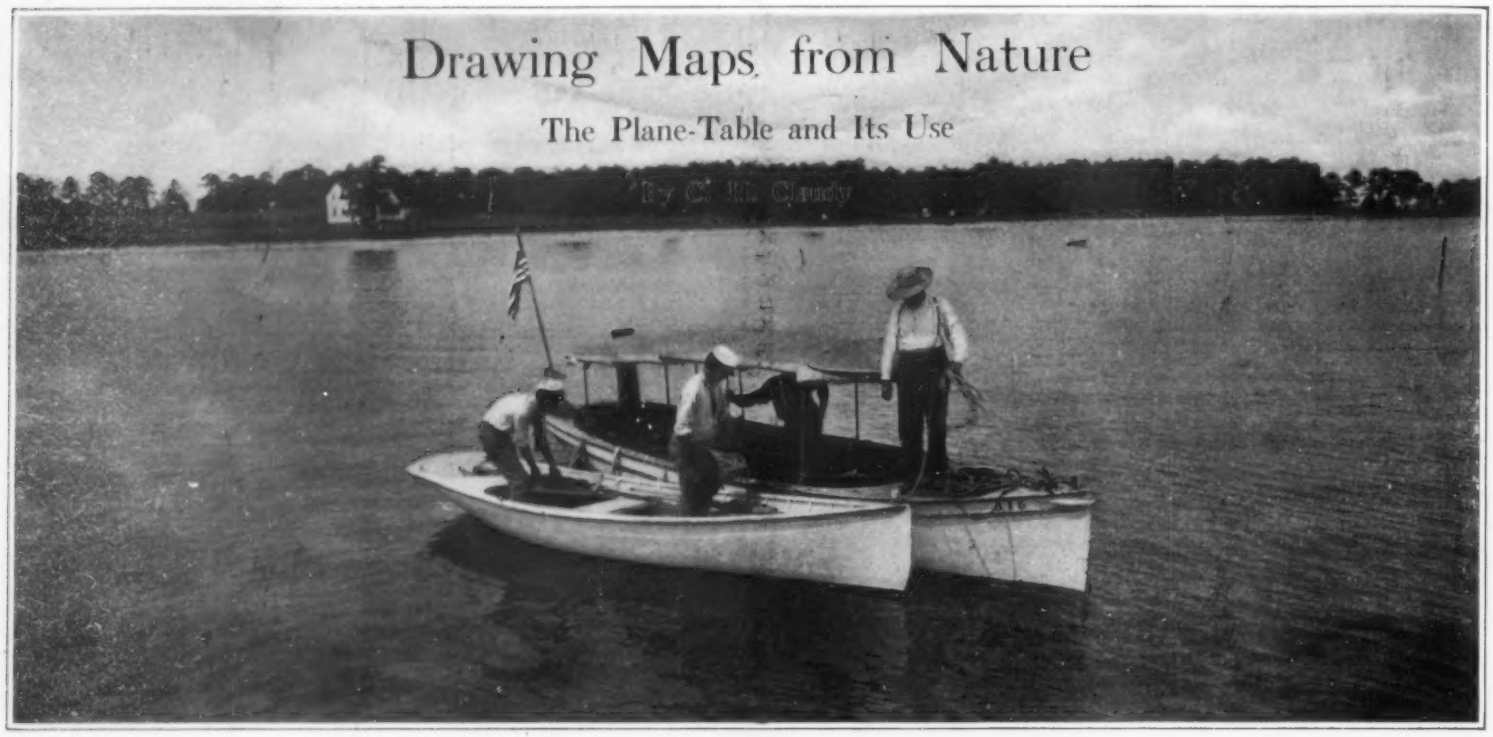
A journal published at the Cape of Good Hope once found itself obliged to employ a kind of brown paper, the sort generally used for parcels; and two successive issues of a native journal at Ahmedabad were printed respectively on a brilliant yellow and a dark green paper.

In 1907 the *Chung Ngoi San Po* marked the occasion of its "jubilee" by appearing on scarlet paper.

Drawing Maps from Nature

The Plane-Table and Its Use

By C. H. Claudy



FROM the tops of the highest mountain peaks to the depths of the most fever ridden swamps, from the regions of snow and ice and cold, so great that stoves must be used to thaw out stiff fingers between every focusing of the alidade, to the regions of such heat and humidity that only mosquitoes and other insect pests prevent the men from working half naked, they go, these map makers, and not one man in a hundred who consults chart or atlas realizes what they do or how they do it; only this he knows, that the result is to be relied upon, and that ship captain or commander of an army may put his faith for the safety of the lives in his charge in the accuracy of the maps furnished him by the government.

Map making and chart making have both many ramifications. The Coast and Geodetic Survey does not only the triangulation work along the coasts, the hydrographic work for depth of water, but the plane table work, the actual outlining of the coast line, from nature herself. The Geological Survey does similar work inland; the Hydrographic Office concerns itself with water map making. Of these several departments, the most picturesque and by no means the least important, is the plane table work, since it is from this work that the charts themselves are drawn.

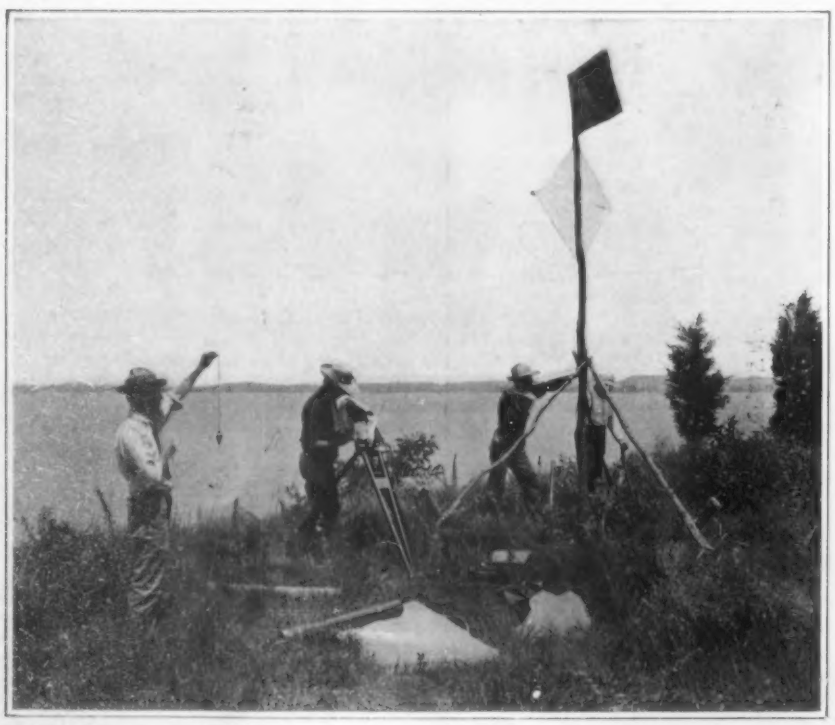
A plane table is exactly what its name implies—a table which can be made plane with the sea level. With it are used a few simple appliances, and with no other means than these, and the triangulation work which has been done before, the maps and charts of our huge coast line, our harbors, our rivers and our lakes, are made.

When a plane table party goes to work they have what is known as the "sheet," a piece of carefully prepared paper, made so as to shrink and expand as little as possible, on which are marked a few dots, indicating the position of certain triangulation points in a certain part of the country. The first thing the party has to do is to select one of these points on the land and erect the table directly over it. The table is of wood, fastened to a "movement," which is supported by a heavy tripod. The plumb bob underneath must point to the signal point on the land. On top of the table, the sheet is unrolled and clipped down, so that the point on the sheet which represents the point on the land, is accessible. Then the alidade is brought into play. This is a small telescope which swings only in a vertical arc and which has for a base a long, thin steel strip, the sides of which are parallel with the line of sight of the telescope. Within the eyepiece of the telescope are cross hairs, which bear a fixed relation to the divisions painted on a rod, known as a telemeter rod.

The alidade is set upon the sheet, one edge of the base touching the point on the paper indicating the signal over which the "station" is erected. The edge of the alidade is also made to touch another triangulation point. The table, previously made level, is now swung around until that other triangulation point, in nature, is visible in the telescope. The table is thus oriented—made so that the sheet is true with the landscape.

A rodman, with the telemeter rod, is then sent out, to stop at the first bend in the coast line. The observer swings the alidade until he can see the rod, keeping one edge of it always on the signal point on the paper. Looking through the telescope, he "reads the rod" for the distance, in meters. Then, with compasses and reducing scale, he makes a mark on the paper corresponding to the distance at which the rodman is placed, the straight edge, of course, giving him the direction. The rodman then moves to the next bend in the coast line, and the process is repeated, only this time the end of the first mark and the second position of the rodman are joined with the pencil, thus putting on paper the exact outline of the coast, measured on the spot, from nature. The charts are usually made on a scale of 1:20000.

Rodmen are worked in pairs, one going ahead, while the other is being "read," and this process is continued until the divisions on the rods can no longer be read through the alidade. Then the whole "station" is moved, and the plane table set up over



Erection of temporary signal. The chief of the party is plumbing the signal while the rest "pack up."

Erecting a recovered triangulation signal.

SIGNALS USED IN MAP MAKING

the spot occupied by the last rodman. The table is oriented upon all the triangulation signals in sight, and the work proceeds. Sometimes a bend in a river or bay will take the party out of sight of all the visible signals, in which case a temporary signal must be set up on the land, plumb, straight and true, and oriented upon the signals in sight, and its position found upon the paper by a dainty surveying calculation known as the three-point problem, in which the observer finds his position within a circle from three known points outside that circle.

Working out this three-point problem is usually done by a sort of trial and error system. If the chief of the party knows his business and must erect a signal somewhere which is not upon his chart, he can usually make a pretty accurate guess as to where to put his pencil on his chart to indicate the spot where his signal will be erected. With this for a beginning, he orients his table on a visible signal and checks it up with other signals. As he has only guessed at the position of the new signal the lines from the other signals, as drawn upon the chart, form a triangle, known as the "triangle of error," somewhere within which the true point of the new signal will be located. By the shape of this triangle, the chief can tell approximately where the true point is. He marks it, and proceeds as before, getting the second time also a triangle of error, but a much smaller one. Successive trials reduce the size of this triangle of error until the exact true point is determined, when the new signal on the land, and its determined position on the chart, become just as effective for further work as a triangulation signal. These temporary plane table signals, however, are only erected for work around corners and up rivers and small inlets, or for traverse work.

Traverse work is required in plane table work for coast charts by the necessity of having something more upon the chart than the mere coast line. Ship captains want to know something about the coast, the roads near it, the small towns, woods, etc., if only as useful information in case of a wreck, although, of course, visual determination of a ship's position at sea, when near a coast, is greatly facilitated by having the character of that coast plainly indicated. So all plane table parties have to consider the necessity of working to some extent inland, and to do this, a "traverse" line must occasionally be run, that is, a crossing over, for instance, a neck of land, or working through some woods, where all signals are for a time, out of sight. In such a case, the rodman, himself, becomes a signal, and the "station," when erected, is oriented on the other rodman over the position of the "station" just left. Two miles can be "traversed" in this way with reasonable accuracy, although, as soon as a signal comes in sight again, it is necessary to "check up" on it, and get rid of any error which may have been made.

Plane table work is thus seen to be not especially difficult in its essentials. But it requires care, good instruments, and personal courage and determination of a high order. The work cannot be prosecuted in rain or snow, because of the damage the elements would do to the "sheet," but other natural factors make the work difficult at times. In certain localities, the mosquitoes are so thick as to make plane table work a torture. The observer must have both hands and his eyes free to manage the instrument. The rodmen must plod through thicket, high grass, swamps and underbrush; when the station is to be moved, every one is so loaded with instruments that there is no chance to fight these pests. It is not uncommon to come on a party doing this work, particularly in Alaska, in summer, with faces and hands one mass of raw, bleeding and swollen flesh. But you will never hear a complaint, so long as the "work" is progressing fast enough.

Much of the work of getting from the station at the end of one day's work, to camp, and getting back the next day, is done with launches. The weather these little boats are forced to endure, and the hazardous landings made in a tender, will make even a waterman wonder, but a plane table party thinks of little beside the importance of the work it is doing; storms, dangerous boating, fever, mosquitoes, even small pox will not frighten them away. There is record of a party which came to survey a small island in a southern bay, and which immediately went to investigate the red and white flags that should have flown from the triangulation signals, but were seen flying from a dead tree near a small cabin. A southern "cracker" came from the house and watched them, incuriously, as they approached.

"Why have you taken our flags?" the chief of the party demanded. "Don't you know it's a penal offense to tamper with the property of the United States?"

"Ya-as, suh!" came the unexpected answer. "I knows it. But we all got fo' cases of small pox in hyer, an' we reckoned yo' all ruther we got yo' all's flags than yo' all get th' 'pits.'"

There wasn't a man in the party who had been vaccinated for ten years. Their work took them within a few feet of the pest house. And there wasn't a man in the party but went quietly and calmly about his work, or even hurried it. Luckily for them, no one got "th' pits," but the danger and the courage were there, none the less.

It is not unusual for a party to find a triangulation signal—a huge structure of boards and timbers—destroyed or carried away, either by the elements, or by the natives, for firewood. When this happens the signal must be rebuilt. If enough of it is left to mark the spot, all that is necessary is lumber, hammers, axes, and some skill. But if it is all gone, the "ground mark" must be sought for. The ground mark is a peg, driven deep into the ground, with the true "point" marked on it. If this is gone, there is another, either a bottle or jar, marked with the true point and buried three feet or more in the earth. Its approximate position must be determined from signs of the old signal, or, if necessary, by working out a "three-point" problem, and then it must be hunted for until found. When recovered, a new signal must be built, from lumber, obtainable locally, from trees cut and trimmed on the spot, or from supplies hauled a long distance away—but the signal must always be rebuilt.

Plane table parties must have for members men who are at once engineers, surveyors, builders, watermen, woodsmen, and inventors. Every possible condition of outdoor living must be met and conquered, every possible difficulty overcome, and through it all, and with it all, the work must proceed. On the accuracy of the work will depend the safety of millions of property, untold numbers of human lives. Imbued with this idea, be the difficulties what they may, the plane table parties of our government press steadily onward, mapping and remapping the coasts of our waterways and our ocean front, a work never to be finished, since coast and waterway lines change constantly, a work indispensable to our welfare as a nation. So that, little known though they may be, ill understood as is their beautiful process of preparing a map "direct from nature," these plane table parties play an important role in the progress of our civilization, and deserve more recognition and honor than has hitherto been accorded to them.

Running a traverse line with the plane table and alidade.

HOW THE PLANE TABLE IS USED

The Total Solar Eclipse of 1911

The Moon's Shadow Traces a Course from Australia to Central America

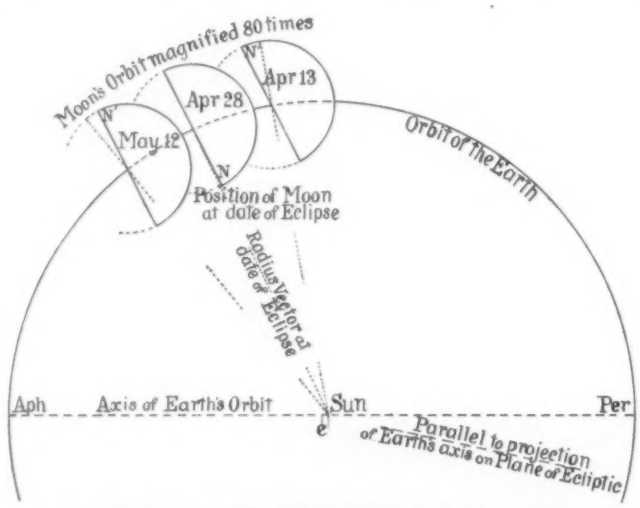
By Frederic R. Honey, Trinity College

THE total eclipse of the Sun, which occurs on April 28th of this year, will be observed under somewhat unusual and interesting conditions. The principal value of a total solar eclipse is obviously dependent upon the possibility of observing the phenomenon from a land area to which it is possible to transport the instruments for observation. In the event of totality occurring in midocean, or in the inaccessible polar regions, the astronomer is deprived of whatever value might accrue to science. But on April 28th an interesting aspect is presented, notwithstanding the fact that totality occurs in midocean; inasmuch as the waters thus visited contain the land areas of the Samoan and Union islands, and the Tonga or Friendly group. Thus is afforded an opportunity for scientific expeditions to these regions, which, though geographically remote, and in some cases must be reached in surf boats, are in no wise discouraging to the enthusiastic observers who will visit them for the purpose of observing the wonderful corona of the Sun. The significance and value of the eclipse phenomena may be judged by the personnel of the several expeditions which are already equipped and on their way to these islands of the equatorial Pacific. The seekers for more light on the science of solar physics are traversing the long distances from such observatory centers as Stonyhurst and South Kensington, England; Sydney, Australia; Lick of California and others, for the knowledge which may be obtained in two to four minutes' view of totality; and even these few precious moments of observation are entirely dependent upon fair weather. With all conditions favorable, the patience of the astronomer who has "pursued the shadow" will be rewarded by the wonderful aureole of light which surrounds the Sun.

The drawings which illustrate this article are designed to show graphically the relative positions of the Sun, the Earth, and the Moon, at the time of the eclipse.

An eclipse cycle of eighteen years and eleven and one-third days—or a Saros (which means repetition) includes on the *average* seventy eclipses, of which forty-one are solar, and twenty-nine are lunar. The period from 1893 to 1910 included forty-two solar and twenty-seven lunar eclipses; and a lunar appulse occurred twice—an average of about four eclipses a year. This year is an excellent illustration of the Saros. Each of the last three eighteen-year periods has included three years during which no lunar eclipse has occurred. The years 1857, 1875, 1893 and 1911 contain no lunar eclipses. A total eclipse of the Sun occured on March 25th, 1857; on April 5th, 1875, on April 16th, 1893, and it will be repeated on April 28th, 1911. An annular eclipse occurred on September 17th, 1857, on September 29th, 1875, on October 9th, 1893, and it will be repeated on October 21st, 1911.

The reason why there will be no lunar eclipse during April or May of the present year will be apparent on an inspection of the plots of the orbits of the Earth and Moon. The latter is magnified eighty times in order to show more clearly the position of the Moon relative to the node; and it will be noted that in magnifying the orbit, the angle between the radius vector of the Earth's orbit and the line of nodes of the Moon's orbit is preserved. On April 13th, fifteen days before the eclipse of the Sun, when the Moon will be above the plane of the ecliptic and approaching the descending node N', and the radius vector of the Moon's orbit will be projected in the radius vector of the Earth's orbit produced, the Moon will be near the node, but not near enough to the plane of the ecliptic to come within the Earth's shadow. Also on May 12th, fifteen days after the eclipse, when the Moon will be below the ecliptic, and the radius vector of the Moon's orbit will again be projected in the prolongation of the radius vector of the Earth's orbit, the Moon will be too far away from the plane of the ecliptic to come within the Earth's shadow. The plot shows the position of the Moon relative to the ascending node N at the time when the projection of the radius vector of the Moon's orbit will coincide with that of the earth. The moon will be very near the node and below the ecliptic; but if it were a little farther from the node, the Moon's shadow would be projected wholly on the southern hemisphere. Fig. 1 is the projection of the Earth on the plane of the ecliptic, and Fig. 2 its projection on a plane which is parallel to its axis and perpendicular to the plane of the ecliptic. The equator, the tropics, the polar circles, and that meridian which passes through the point from which the central eclipse will be visible at noon, are shown in both projections. The point from which the central eclipse will be visible at noon will be very near the equator (lat. 0.6 deg. S.; long. 154.7 deg. W.), and will be below the plane of the ecliptic corresponding to the situation shown in the plot of the Earth's orbit. The Sun will be totally eclipsed, and the proportion between the apparent diameters of the Sun and Moon at the time of the eclipse is shown in Fig. 3.



Relative positions of Sun, Moon and Earth at date of eclipse.

Fig.1.

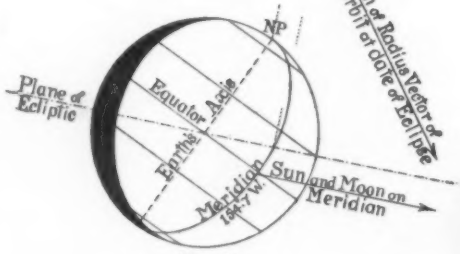
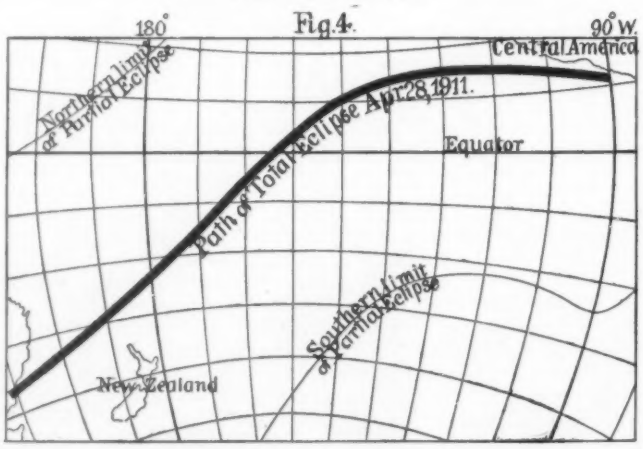


Fig.2.

Fig.3.

Position of the Earth and apparent diameters of the Sun and Moon at the time of the eclipse.

Fig.4.



Path traced by the Moon's shadow.

The oxygen gas escaping through the hollow stopper under a pressure of only a few inches of water was conducted through a long copper tube to a purifier containing platinized quartz. Although this purifier was used constantly no impurities were found in the gas. From the purifier the gas was conducted through a valve-head to a two-liter cylinder of heavy brass lined with nickel. This cylinder was suspended in a bath of liquid air at atmospheric pressure. Fresh made liquid air boils at about 9 deg. C., lower temperature than oxygen, and this difference was sufficient to cause the oxygen to liquefy. When the brass cylinder was filled with liquid oxygen, the current was shut off from the electrolytic apparatus, a common steel flask was connected up with the valve head, the liquid air bath removed, and the liquid oxygen at once began to vaporize owing to the heat received from the surrounding atmosphere. When the gage on the valve-head indicated sufficient pressure the valves were closed, and another flask was substituted for the filled one. The oxygen thus obtained was found more than 99.9 per cent pure. It will be seen that oxygen produced in this way is as near absolute purity as is possible. It is an expensive process, however, and cannot compete with the liquid air rectification process.

Fig. 4 shows the path of the total eclipse which extends from Australia across the equator to Central America. As a partial eclipse it will be visible in the eastern part of Australia and New Guinea, and will include Van Dieman's Land, New Zealand, and the islands to the north. It will be visible in the United States, Mexico, and Central America. Washington will be very near the limit of visibility, where a small partial eclipse will be seen, the Sun setting eclipsed.

A Novel Method of Obtaining Pure Oxygen

THE chemical laboratory of the National Bureau of Standards recently had need of a large quantity of practically pure oxygen gas in carrying out certain work. This gas was prepared in one of the physical laboratories of that institution by the electrolysis of water. The positive electrode was suspended in an ordinary round quart bottle with its bottom removed. This bottle was provided with a hollow metal stopper which formed part of the electrical connection between the positive electrode and the outside main. The electrolytic apparatus was placed outside the building, and as the hydrogen given off at the negative pole was not needed, it was allowed to go to waste.

Correspondence

Preferential Rates and American Shipping

To the Editor of the SCIENTIFIC AMERICAN:

I think your suggestion as to lowering duties on goods imported by American ships the proper solution of a vexing problem. What the people object to is the payment of money directly out of the Treasury to private shipowners. The lowering of the duty on cargoes imported by American ships would remove this objection, while the lowered duty might lead to increased imports, which would not lessen the revenue of the government. W. R. SMITH.

Woodbury, Tenn.

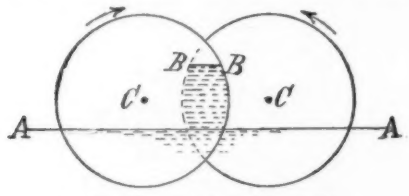
A Perpetual Motion Device

We have received from Mr. Thomas Childs an interesting communication in which he describes a "perpetual motion machine" presenting some apparently novel features. Our readers may find it interesting to search out the fallacy of this ingenious device. We therefore reproduce below the main gist of Mr. Childs's letter:

To the Editor of the SCIENTIFIC AMERICAN:

The accompanying sketch illustrates a device which should apparently furnish a continuous and perpetual supply of power.

In the diagram the line *A A* represents the level of water in some suitable container in which the apparatus is placed. This apparatus consists simply of two or more disks arranged to readily rotate about their axes at *C C*, as shown, the overlapping portions of the disks being placed close to one another, so that the water rises between them to the level *B B* by capillary action. The effect of the weight of the water



Capillary perpetual motion machine.

thus drawn and supported on one side of each disk, should be, it seems, to make both wheels turn in the direction indicated by arrow heads.

Sumter, S. C. THOMAS CHILDS.

Fire Drills in Factories

To the Editor of the SCIENTIFIC AMERICAN:

Your editorial on the subject of "Fire Drills in Factories," in the April 8th issue, is a strong argument for legislative action upon something that is certainly needed as much in industrial establishments as in schools, if not more so, on account of the entirely different conditions to be found in factory and school buildings; but it will perhaps be a difficult matter to enforce the observance of a law making fire drills compulsory, if the duty of conducting drills devolves upon factory owners. The average factory owner or superintendent of a factory similar in character to the one in which the recent terrible loss of life occurred in New York, is usually too busily engaged in keeping his work people "speeded up," to give attention to what he would probably term "a waste of time." And where is the man, or woman for that matter, in a manufacturing or mercantile establishment of any description who will admit the possibility of fire originating within their own premises? I have failed to find one during many years of experience in visiting factories. "We have been in business for forty years and never had a fire," is heard quite often in factories. Most school buildings are provided with ample means of exit; desks and chairs are fastened to the floors in regular rows with aisles between; there are no piles of light inflammable material heaped up or suspended over large areas, to come in contact with lighted jas gets; the pupils, as a rule, do not smoke cigarettes in the buildings, as do ninety-nine per cent of the male employees in the various branches of the clothing industry; there are no motors to spark, no shaft bearings to run hot, no oily rags or waste materials to accumulate, nor any pressing-table stoves to be supplied with gas through leaky rubber tubing. All of these and other hazards exist in a shirtwaist or clothing factory, and the sewing machines are usually placed close together on long tables, between which are the chairs, work boxes, etc., of the operators; and in an emergency every chair and box becomes an obstruction in the narrow passages. It is not only the people of foreign parentage nor the lately arrived immigrant that will become uncontrollable in the occurrence such as the one you have referred to. for no one is *panic proof* when his escape from fire is cut off, and there is no arrangement of fire escapes applicable to a ten-story building that will serve the needs of several hundred people endangered by smoke and flames. The building of moderate height is no exception to the rule, for many persons have been compelled to jump from second-story windows.

But you have sounded the keynote of this most important theme in your suggestion that "it should be made compulsory for the landlord or lessee to install an effective system of automatic sprinklers." And it is of daily occurrence that efficient systems of sprinklers either put out fires in their incipiency, or so hold them in check as to give people a reasonable time to escape, and the fires are practically extinguished when the firemen arrive. We do not often read of these occurrences in the daily press, for they are *not* advertised—it being only when fire gets beyond control and lives are lost that attention is paid to such matters; but records are kept by those interested in sprinklered risk fires, which can easily be procured from the National Fire Protection Association, 87 Milk Street, Boston.

In some cities sprinklers are required by law in theaters, in the basements of large mercantile buildings and in basements of school buildings, for that is where school fires usually start, either from defective heating appliances or from bad housekeeping.

Why should the far more hazardous factory building be exempt from such a law? Sprinklers are not new; the cost of installation is not exorbitant, nor is the business monopolized by a corporation. The sprinkler equipment is a profitable investment; not only through reduced cost of insurance, but when it is considered that serious loss by interruption to business is prevented by a very simple device, which merely requires the maintenance of a few thousand gallons of water. Modern buildings will prevent the spread of fire beyond certain limits; but the contents need as efficient protection as in the ordinary frame structure, and the automatic sprinkler is the only known device for such service.

Philadelphia, Pa. P. D. C. STEWARD.

The Planetary Gear Problem

In our issue of February 18th, 1911, Mr. Joseph de Martino suggested to our readers a mechanical problem. It was required to find the number of revolutions of the central gear wheel for one revolution of the satellite when the peripheral (internal) gear was held fixed, and *vice versa*. We have received a large number of communications giving solutions by various methods. Most of the answers to the problem were correct. A number, however, were short of the true answer by just one revolution. Thus, one correspondent says: "Gear *C* will make as many revolutions as the number of teeth in gear *C* is contained in the number of teeth in gear *A*." He thus obtains for his solution of the first problem:

$$1\tfrac{50}{61},\ 3,\ 5\tfrac{2}{7}.$$

Whereas the true answer is:

$$2\tfrac{50}{61},\ 4,\ 6\tfrac{2}{7}.$$

We have selected from the many solutions sent in two which seem to commend themselves for their lucidity and briefness. These are reproduced below.

To the Editor of the SCIENTIFIC AMERICAN:

I offer the following solution of the problems of Joseph de Martino on page 162 of your issue of the SCIENTIFIC AMERICAN of February 18th:

Let *D* be the circumference of the circle described by the hub of circle *B*, and let *d* be the radius of this

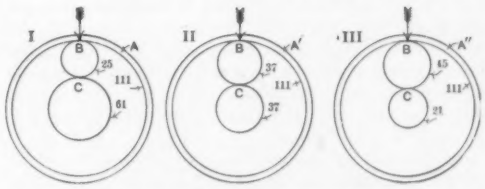


Diagram of mechanical problem.

circle, and *b* and *c* the radii of wheels *B* and *C* respectively.

Then $d = b + c$ in all the six cases.

$2\pi d = 2\pi (b + c) = 2\pi b + 2\pi c$. Therefore the circumference of *D* equals the sum of the circumferences of *B* and *C*. Let us use one cog as the unit.

Then $D_{\mathrm{I}} = 86$; $D_{\mathrm{II}} = 74$; $D_{\mathrm{III}} = 66$.

Now a point on a rolling wheel diametrically opposite the point of contact moves twice as far as the hub. The power wheel always engages this opposite point. So a point on the power wheel will move twice as far as the hub of *B*, i. e., a distance equal to 2 *D*.

So this distance, 2 *D*, divided by the circumference of the power wheel, will give the number of revolutions the power wheel makes.

The solution of the first problem is therefore as follows:

$$\frac{2D_{\mathrm{I}}}{61} = \frac{172}{61} = 2\tfrac{50}{61}$$

$$\frac{2D_{\mathrm{II}}}{37} = \frac{148}{37} = 4$$

$$\frac{2D_{\mathrm{III}}}{21} = \frac{132}{21} = 6\tfrac{2}{7}$$

When the central wheel is fixed, the number of revolutions of the internal gear is similarly obtained by dividing the total travel, expressed in number of teeth, by the number of teeth on the internal gear.

$$\frac{2D_{\mathrm{I}}}{111} = \frac{172}{111} = 1\tfrac{61}{111}$$

$$\frac{2D_{\mathrm{II}}}{111} = \frac{148}{111} = 1\tfrac{1}{3}$$

$$\frac{2D_{\mathrm{III}}}{111} = \frac{132}{111} = 1\tfrac{7}{37}$$

FREDERICK D. STETSON.

To the Editor of the SCIENTIFIC AMERICAN:

In answer to Mr. de Martino's problem, I offer the following solutions:

I. $2\frac{50}{61}$; 4; $6\frac{2}{7}$.

II. $1\frac{61}{111}$; $1\frac{1}{3}$; $1\frac{7}{37}$.

III. The simplest method of arriving at these results seems to me to be as follows: (1) Suppose that the plate carrying the satellite gear *B* is *stationary*. Then (supposing that the three gears *A*, *B*, *C* have *a*, *b*, *c* teeth respectively) it is easy to see that *A* and *C* will revolve in *opposite* directions at *c*, *a* revolutions per minute respectively. We may represent this thus:

A ——— (*c*)
B ... ...
C ←——— (*a*)

(2) To find out what happens when *A* is held stationary, conceive that the *whole* system revolves at the rate of *c* revolutions per minute to the *left*. Then the diagram becomes

A ...
B ←——— (*c*)
C ←——— (*a* + *c*)

Hence when *B* makes *one* revolution, *C* makes $\frac{a+c}{c}$ revolutions.

(3) When *C* is to be held stationary, conceive that the system represented in (1) revolves as a whole to the *right* at the rate of *a* revolutions per minute. Then the diagram becomes:

A ———→ (*a* + *c*)
B ———→ (*a*).
C .....

Hence when *B* makes *one* revolution, *A* makes $\frac{a+c}{a}$ revolutions. The particular cases given can now be worked out. IMMO S. ALLEN.

London, England.

The Current Supplement

THE opening article of the current SUPPLEMENT, No. 1842, is devoted to a very thorough review of the English Aero and Motor Exposition at Olympia, London.—Mr. Walter V. Turner's article on "The Air Brake as Related to Progress in Locomotion," is continued.—Some formulæ for frosting, etching and coloring incandescent lamps are given.—The Paris correspondent of the SCIENTIFIC AMERICAN reviews the recent work done by Capt. Ferrié in wireless telegraphy from airships.—George C. Rice, Chief Engineer of the Bureau of Mines, contributes an article on the plan and purpose of the experimental coal mine which the United States Bureau of Mines has established at Bruceton, Pa.—Mr. F. Alex. McDermott writes instructively on the chemistry of biophotogenesis, which, in its complete sense, is the production of light by living organisms.—The camphor industry is described.—Over twenty-five years have passed since Wilhelm Roux published his first contribution to the mechanics of evolution, in which he indicated an effective method of analyzing the complex processes by which an individual organism is developed. Since his time much progress has been made, progress which is reviewed in an article entitled "A Quarter of a Century of Experimental Embryology."—"Road Making in the United States" gives the present status of the use of bituminous materials.—"Psychanalysis" is a new word, which, in terms comprehensible to the layman, has been defined as the science of reading the inmost secrets of the heart and soul in spite of—sometimes without the least suspicion on the part of—the person who is the subject of investigation. The progress that has been made is summarized.

Science in the Current Periodicals

In this Department the Reader will find Brief Abstracts of Interesting Articles Appearing in Contemporary Periodicals at Home and Abroad

"Investigating" Peary

THE trials and tribulations of Robert E. Peary in obtaining recognition for his remarkable polar explorations are fully recorded in Congressional records. Our contemporary, *The Navy*, has performed the commendable task of lifting out of their obscurity these interesting documents, which should be placed before every American reader, so that he may know why it is that Robert E. Peary has been made a rear admiral, and why European scientists, in particular, have so unstintingly accorded that full meed of praise which he so richly deserved. From *The Navy* we cull the following interesting particulars:

The Committee on Naval Affairs made an extended report wherein it was stated: "Robert E. Peary reached the North Pole on April 6th, 1909. From a camp, which he established at a point estimated by observation at 89 deg. 56 min. north latitude on said date (slightly over four miles from the exact pole), he made two excursions on that and the following day, which carried him close to and beyond the pole."

Capt. Peary appeared in person before the committee and gave important testimony, submitting all his papers, original data, the daily journal kept by him during the journey, and notes of astronomical observations and soundings, etc. The committee had before it the report of the National Geographical Society of Washington and a report from the president and one of the board of governors of the Royal Geographical Society of London. An independent examination of the data and proofs was made and a report was submitted to the committee by Hugh C. Mitchell and C. R. Duvall, expert computers of astronomical observations of the Coast and Geodetic Survey of the United States. Messrs. Mitchell and Duvall came to the conclusion that Peary passed within a little over a mile of the exact pole, and that the march of April 7th, 1909, may have carried Peary even within a stone's throw of that point.

"The hearings established the fact that Peary reached the North Pole on the above-named date in pursuance of a well-defined and carefully laid plan, which he had been able to formulate as the result of more than twenty years' Arctic experience, and which he was able to carry out because of an indefatigable earnestness and singleness of purpose.

"As a result of this plan, when he reached out over the Arctic Sea, as had been done by other explorers—Nansen, Greely, Lockwood, Markham, and others—and came to a point beyond where they had turned back, and beyond where he himself in former excursions had been obliged to retreat, he was able, by reason of his supporting parties, to go forward with sledges filled with provisions and fresh dogs for locomotion, these very essentials of success having been conserved for his final dash.

"Three years before, in 1906, Peary had reached 87 deg. 6 min. N., the farthest north ever attained up to that time. He then learned the necessity of more careful preparation, and, returning to the United States, planned a campaign by ship, men, Eskimos, dogs, canned provisions, lighter equipment to the very last detail, which resulted in success.

"Peary was an officer of the United States navy, and charged with the specific duty in which he was engaged. President Roosevelt, July 3rd, 1908, detailed Peary to report to the Superintendent of the United States Coast and Geodetic Survey, and instructed that Peary be ordered to make tidal observations along the Grant Land and Greenland shore of the Polar Sea."

As to the accuracy of Peary's computations, the committee states among other things:

"Mr. Mitchell and Mr. Duvall figured the position of Peary at the pole independently, but based on the same observations and by independent methods. Their calculations agree within a second of latitude.

"Mitchell states that from his professional experience it would have been impossible for the data of these observations to have been obtained other than under the circumstances claimed. The observations at the pole were made at different times. He states that in using these observations in connection with each other they, in a measure, prove each other, and that error could be detected had the observations not been made at the points set forth in the data."

As to the matter of an error in his chronometer, which has been used as the basis of certain attacks upon Peary's claim that he reached the pole, the committee has to say:

"This very error proves the truth of his position and the correctness of his observations, based upon his own chronometer. Had his chronometer been exactly correct, Camp Jesup would have been in direct line with the pole, as he had supposed from his own observations, and the forward march would have brought him exactly over its location. His detour to the right, however, on the following day brought him within 1.6 miles of the exact center, which is substantially the goal he sought."

The committee comments further as follows:

"It is a well-recognized fact that exact results are not attainable as a result of observations. A matter of one or two miles under favorable circumstances is a fair allowance. Dr. Nathaniel Bowditch, in the *American Practical Navigator*, an official publication of the United States Navy Department, states:

"In obtaining results of observations it is impossible to make an exact allowance for error in chronometer and sextant and error of refraction and of observation. No navigator should ever assume that his position is not liable to be in error to some extent, the precise amount depending on various factors, such as the age of the chronometer rate, the quality of the various instruments, the reliability of the observer, and the conditions at the time the sight was taken. Perhaps a fair allowance for this possible error under favorable circumstances will be two miles; therefore instead of plotting a position upon the chart and proceeding with absolute confidence in the belief that the ship's position is on the exact point, one may describe, around the point as a center, a circle whose radius is two miles (if we accept that as the value of the possible error) and shape the future courses with the knowledge that the ship's position may be anywhere within the circle."

From *The Navy*.

Positions plotted from observations made by R. E. Peary in the vicinity of the North Pole.

Polar discovery has always been recognized by the country to whom the explorer belonged. Shackleton, who reached a point within a hundred miles of the South Pole in 1909, was granted £20,000 by the British government and knighted by the King. William E. Parry, in 1827, reached 82 deg. 45 min. (the record of the farthest north), and was knighted by the King. Sir John Franklin, for explorations of the Arctic coast, was knighted, as were also John Ross in 1835, James Ross in 1844, Robert McClure in 1853, McClintock in 1855, and Nares in 1877.

The President of the United States and the Secretary of the Navy accordingly recommended that Peary be recognized fittingly. Scientific societies of the world unanimously pronounced this the greatest geographical prize of the last three centuries. It is a matter of just pride that this honor has come to the United States. The committee believed that "in view of his long distinguished service in the Arctic regions in ascertaining the northern boundaries of Greenland; his soundings and tidal observations; his ascertainment of facts concerning the northern Arctic Ocean; the general information he has obtained by living over twelve years within the Arctic circle; and finally having successfully followed a carefully laid plan resulting in his reaching on April 6th, 1909, and bringing back to civilization the conditions existing at the North Pole, that Robert Edwin Peary has performed a most remarkable and wonderful service, that he has attracted the favorable attention of the civilized world; and that therefore the American people, through its Congress, shall render him thanks, and bestow upon him the highest rank of the service which he adorns."

Dr. Cook's remarkable tale and its subsequent disproval had instilled so much doubt in the minds of many people, that not all the committee were in accord. A minority report accompanied the majority report of the committee. At the conclusion of Capt. Peary's examination the accompanying diagram was exhibited, on which are marked the points in the vicinity of the pole where he had made his astronomical observations. These points were determined by working out his observations and plotting them on the diagram. The diagram was made by Mr. Duvall, and was verified by Mr. Mitchell. The work of these two men, so far as the committee was able to ascertain, was the first and only effort made to verify in a practical way Capt. Peary's maps or records. No doubt if the National Geographical Society had proceeded in the same manner, an unpleasant controversy might have been avoided. Mr. Peary was reluctant to submit to any tribunal other than the National Geographical Society his records and memoranda, because he had signed contracts with his publishers long previously which rendered it impossible for him to publish his records of scientific data at a time when the public clamor first arose. Not only would he have been subjected to heavy damages—a loss which he could not have met, because he had barely succeeded in extricating himself from debt incurred in connection with polar explorations—but he would have broken faith with his publishers.

The doubts which had been raised, however, both by Peary's refusal to submit his records to any other body but the Geographical Society, and also by the exposure of Dr. Cook, naturally had its effect upon the committee. There was not complete accord in awarding to Peary the honors so justly due him. Hence there was a minority report, the reading of which is not exactly instructive, but is certainly amusing. The leading light among the minority was the Hon. R. B. Macon, Representative from the First District of Arkansas, who, to use the terms of *The Navy*, "gained fame by skill in coarse vituperation." It is alleged by *The Navy* that on the floor of the House he referred to a reputable newspaper reporter as a "liar," and spoke of Peary as "near-hero," an "alleged discoverer," and an "idle loafer." In the heckling to which he was subjected by Mr. Macon, Mr. Peary conducted himself with dignity and certainly with great self-restraint, as the following excerpt from the records must certainly show:

Capt. Peary. I do not think I care to go into a discussion of general principles. I will state the facts, and also my determination of those facts, to the committee or to any experts.

Mr. Macon. You are an explorer, so reputed, and we want to find out whether or not you knew what you were doing. When you send a man into the field to plow he must know something about the work or he will not do much intelligent work.

Capt. Peary. Specifically or precisely the magnetic pole is located somewhere here (indicating on map) near King William Land, just a little north of the mainland of the American continent. There is a gentleman here who can probably give you the precise point.

Mr. Macon. We are examining you here now and not examining the other gentleman.

Mr. Macon. Captain, did you find any evidence of increase or diminution of weight at the pole?

Capt. Peary. I did not, except the weight of the members of the party and the dogs.

Mr. Macon. I mean change in weight except for lack of food-stuff?

Capt. Peary. I beg your pardon?

Mr. Macon. Did they change except perhaps for lack of food-stuff?

Capt. Peary. Not that I noticed; no.

Mr. Macon. Did you find any decided atmospheric changes?

Capt. Peary. I did not.

Mr. Macon. Did the needle answer to the primary or the secondary magnetic pole?

Capt. Peary. The direction of the compass was fairly constant there.

Mr. Butler. Will you tell me, please, what that means?

Mr. Macon. I asked him whether the needle answered to the primary or secondary magnetic pole.

Mr. Butler. What are they?

Mr. Macon. Oh, they are known in science.

Mr. Bates. Where did you find that question?

Mr. Macon. They are known in science.

Mr. Bates. But I am not a scientific person.

Mr. Dawson. I would be glad if the gentleman from Arkansas would explain.

Mr. Macon. The gentleman from Arkansas is going to ask questions, and he is not going to ask any foolish ones, either.

Mr. Englebright. Is he trying to test the Captain's knowledge on science by asking such questions—ridiculous questions?

Mr. Macon. I have asked no ridiculous questions.

Mr. Englebright. Did you ever hear of a primary or secondary magnetic pole?

Mr. Macon. Yes; I have.

Mr. Englebright. Where—in Arkansas?

Mr. Macon. Where I have heard of everything else—no; in Washington. And I want to say to the gentleman from California, if he intends it as a slur in regard to Arkansas, that it is unworthy of him.

Mr. Englebright. I withdraw the remark.

Mr. Macon. I want it understood that Arkansas is the equal of California in everything in the world except a little gold in the earth and a few hungry fellows for an exposition.

Mr. Butler. I will ask the members of the subcommittee not to further interrupt you.

Mr. Macon. I am advised by a school of scientists that it is a physical impossibility for man or beast to reach the North Pole, for the reason that the diminishing centrifugal action—did you ever hear of that?

Mr. Butler. I never did. I have heard of dogs and sledges, though.

Mr. Macon. For the reason that the diminishing centrifugal action and, in proportion, the increasing center of gravity near the pole causes a complete failure of man and animal energy that produces a kind of paralysis of the senses and of motion, a paralysis of sensation in any part of the body, including the exercise of the faculty of the mind. Do you know anything about that contention on the part of scientists?

Mr. Butler. That is an indication of lunacy, is it not, or feeble mind—a sort of combination of the solids and fluids?

Mr. Macon (continuing). So that it would be almost impossible for them to exercise their independent functions so that anybody could ascertain a real fact—intelligently ascertain a fact.

Mr. Butler. What was your observation?

Capt. Peary. I have never heard of the matter.

Mr. Butler. You never did?

Capt. Peary. I never heard of the subject matter of the question.

Mr. Macon. You never heard of that before?

Capt. Peary. Never heard of that before.

Mr. Butler. Never heard of the theory——

Capt. Peary. And I have not noticed any such condition or effect or circumstance.

Mr. Butler. On either man or dog?

Capt. Peary. On any member of my party or dogs.

Treating Cutaneous Disease by Means of Cold

AN interesting and promising method of treatment has lately been employed in various diseases. It consists in the application of intense cold to circumscribed and easily attainable parts of the body—chiefly to the external skin, but also to the mucous linings of the cavities of the body.

This method, like many other apparently violent therapeutic procedures, appears to have originated in America, where it was employed by Pusey. Soon afterward it was shown at the dermatological congress held in Frankfort three years ago. Practical methods of applying the principle have since been developed, more or less successfully, by many German physicians.

The treatment of cutaneous diseases by the application of cold produced by liquid air was attempted in Germany long ago, but the results were unsatisfactory, owing to the physical peculiarities of liquid air and the employment of excessively low temperatures. The American experiments proved that the temperature of carbonic acid snow, —112 deg. F., is quite low enough.

This snow is easily produced by allowing liquid carbonic acid to flow from a commercial cylinder of the compressed gas into a porous vessel, which retains the snow formed by the refrigerating effect of evaporation. This snow can be molded like ordinary snow and can be used directly for therapeutic purposes, but it must not be grasped tightly with bare hands, as it produces "burns." The physiological effects of its application, indeed, resemble those of some burns, but are usually beneficial, rather than malignant. Dr. Axmann, who describes this new therapeutic procedure in *Die Umschau*, has never caused a permanent lesion in any of the hundreds of cases which he has treated, nor has he heard of any such accident. He has devised a very simple and convenient apparatus, consisting of a frame which securely holds the carbonic acid cylinder, with its mouth downward, and a leather pouch which is attached to the mouth of the cylinder directly or by means of a short tube. By repeatedly opening the stop-cock for a few seconds, liquid carbonic acid is expelled in small portions into the pouch, where the evaporation of part of the liquid freezes the rest. The snow that accumulates in the pouch is transferred to glass or metal tubes, ½ inch to ¾ inch in diameter and 4 to 6 inches long, in which it is compressed by pistons until it issues from the mouth of the tube as a solid cylindrical or polygonal rod, which can be applied directly to the skin.

The depth to which the action penetrates can be regulated by the pressure with which the rod of carbonic acid snow is applied. When the flesh is touched lightly it is protected by a stratum of carbonic acid gas which its heat evolves from the snow, but this insulating coating of gas is squeezed out by vigorous pressure. This effect, which is known as Leidenfrost's phenomenon, accounts for the fact that carbonic acid snow can be touched lightly with impunity but "burns" the fingers when grasped firmly.

The duration of the treatment is measured by seconds. Ten seconds' application, with firm pressure, raises a blister and entirely destroys the outer skin; sixty or even thirty seconds may produce deep-seated and serious effects. If proper caution is observed, however, no permanent injury results. The frozen and pitted skin presents an alarming appearance, but in a few seconds the normal aspect has returned and the pain, which is usually slight, is entirely gone. Inflammation, swelling, and blisters come later, but in a week a new skin, often free from the imperfections of the old one, is formed.

The treatment is especially efficacious in a variety of disagreeable and disfiguring, but not serious, affections of the skin, such as the red, blue or brown moles which sometimes thickly cover the face. It also gives excellent results in obstinate cancer of the skin (cancroid), and various small tumors of the nature of warts. The carbonic acid method is particularly indicated for the treatment of small blemishes of the skin, as it can be applied without causing serious pain, scars or any injurious effect.

Psoriasis, a rather common skin disease, which though not dangerous is very annoying, and which has rarely if ever been completely and permanently cured, has in recent years been treated successfully with ultra-violet rays and Roentgen rays. Even the latter, however, leave patches of eruption, the removal of which by repeated application of Roentgen rays would be both expensive and dangerous. These patches yield to the cold treatment, which is preferable to ray treatment in all cases of small local infection with psoriasis.

The new method will also be found useful in surgery. A pencil of solid carbonic acid can be introduced into the nasal cavity or a wound fistula without difficulty, and is a safer and more efficient agent for the destruction of morbid growths than the electric cauterizing needle, the temperature of which is variable and uncertain.

Some Effects of the Foehn Wind

THE foehn is easily the most famous wind of the Alps, yet there are few good descriptions in English of its many and far-reaching effects upon human affairs. Thanks to Hann, the mechanism of this wind is well understood; the textbooks of meteorology tell us how it acquires its remarkable heat and aridity, in traversing the mountains, but do not give us an adequate idea of the way in which these qualities influence the lives of the people who dwell where the foehn is prevalent.

Innsbruck, the capital of the Tyrol, is a favorite haunt of the foehn, and from this place have come the most complete scientific discussions of the wind; viz., the "Innsbrucker Föhnstudien," which have been in course of publication for the past six years. However, perhaps the most graphic picture of the effects of the foehn is contributed to a recent number of *Symons's Meteorological Magazine* by an anonymous resident of Innsbruck.

At Innsbruck the foehn is *the* wind—the only one that counts. "Es geht wieder der Wind!" says the shopkeeper who is serving you, while the foehn is doing its best to break his windows, and is enveloping the passers-by in clouds of dust.

The precursors of the foehn are promptly recognized. The atmosphere becomes pure and limpid, distant hills are a marvelous transparent blue. Soft diaphanous clouds begin to gather in the southern sky; a few fleecy clouds form around the mountain summits, and at times these develop with incredible swiftness into a great bank—the "foehn-wall"—blotting the southern horizon from view.

Most remarkable is the sudden rise in the temperature. If it is summer the atmosphere becomes stiflingly hot, if winter the keen frosty air turns mild and close. This wind often blows with great violence, and unless one's windows are promptly closed everything in the house is speedily covered with a thick layer of dust.

Upon many people the foehn has a pathological effect, the symptoms of which—headache, lassitude, depression—are classed together under the term "foehn-sickness." Trabert has endeavored to explain this as the result of the fall in barometric pressure; Czermak and others refer it to the electric disturbance of the atmosphere that accompanies the foehn.

In spring, frost and snow disappear as if by magic at the touch of the foehn—hence called the *Schneefresser* ("snow-eater"). This fact has a sinister significance for Innsbruck, as a favorite center for winter sports. The ski-runner beholds with dismay the complete disappearance of the snow, in a few hours, from the mountain slopes; while the skater sees the ice turning to water beneath his eyes. More serious is the effect of the foehn in loosening the dreaded avalanche. To offset these disadvantages, the foehn is a valuable asset to the agriculturist. Innsbruck owes its crops of maize to the foehn; the cultivation of this plant would be impossible without it. To the mild temperature brought by the foehn is due, also, the occurrence at Innsbruck of semi-tropical types of vegetation—survivals of an interglacial period that succeeded the great Ice Age.

Bad weather—rain or snow—almost invariably follows the foehn at Innsbruck.

The most remarkable and disastrous effects of the foehn are, however, to be sought, not at Innsbruck, but in certain Swiss valleys, where the extreme dryness of the wind, by reducing all woodwork to the condition of matchwood, increases the danger of fire to such an extent that in certain localities fire of any kind, from that of the kitchen stove to that of a lighted cigarette, is strictly prohibited during the foehn. There are also regions where the foehn blows far more violently than at Innsbruck, uprooting trees, unroofing houses, etc.

The article above referred to does not furnish details regarding these more serious effects of the foehn, but the reader who desires to pursue the subject further may do so in Gustav Berndt's "Der Alpenföhn in seinem Einfluss auf Natur- und Menschenleben," published as the eighty-third supplementary number of *Petermann's Mitteilungen*. Here we read of the great "foehn fires" that have three times laid in ashes the village of Altorf; that have raged four times in the town of Glarus; and that half destroyed the quaint old town of Meiringen, February 10th, 1879. Many Swiss villages have their fire-wardens, who patrol the streets when the foehn is blowing, and see to it that the laws requiring all fires to be extinguished under such circumstances are rigidly enforced. Fires for cooking are permitted during specified hours, unless the foehn is unusually severe and persistent, when even this meager privilege is denied, and the villagers must subsist on cold food.

The Loss of Power in Gas Engines at High Altitudes

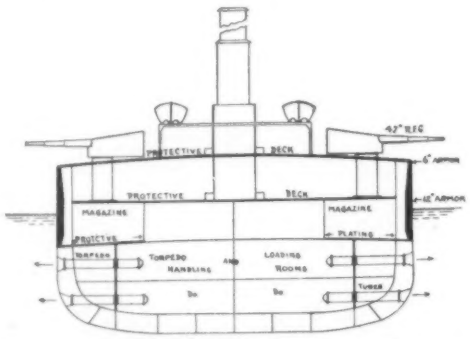
IN a recent issue of the *Engineering Review* there will be found recorded the case of a large gas plant which was some time ago exported from Great Britain to a British colony and erected at the location several thousand feet above sea level. The engines did not give the power expected from them, and several reasons were advanced to account for this deficiency. It was finally concluded that the loss of power was due to the altitude of the power station. Upon investigation of the theoretical and practical considerations involved it was found that there is a loss of about one per cent of the indicated horse-power for each 1,000 feet increase in elevation. The effect of an increase in elevation on an engine with a low ratio of compression is slightly less than on an engine with a high degree of compression.

Battleship versus Destroyer

The Struggle Between the Big Gun and the High-speed Torpedo

THERE are not wanting some careful students of the trend of naval construction who believe that the ultimate arbiter of future battles on the high seas will be the torpedo, and not the big rifled gun. This conviction is based upon the ever-increasing accuracy and ever-extending range of the torpedo and upon the great improvement which is being made in torpedo vessels, and particularly in those of the submarine type. Also, some of the best naval architects of the day are studying the question of building the torpedo-boat destroyer on battleship lines, giving her sufficient size and speed to overtake the battleship, and sufficient armor to enable her to run in within easy striking range of the enemy.

At the present writing, so great is the power and so unerring the accuracy of the big gun (witness the recent target practice of our ships against the old "Texas") that except under the very rare conditions of a surprise attack in fog or thick weather, the big-gun battleship has the torpedo craft at its mercy—the destroyer is too frail and the submarine too slow, to have any hope of getting near enough to a modern dreadnought to launch the torpedo with any chance whatever of a successful hit. But when it comes to the question of building destroyers of the size, speed and protection of the extraordinary vessel shown in

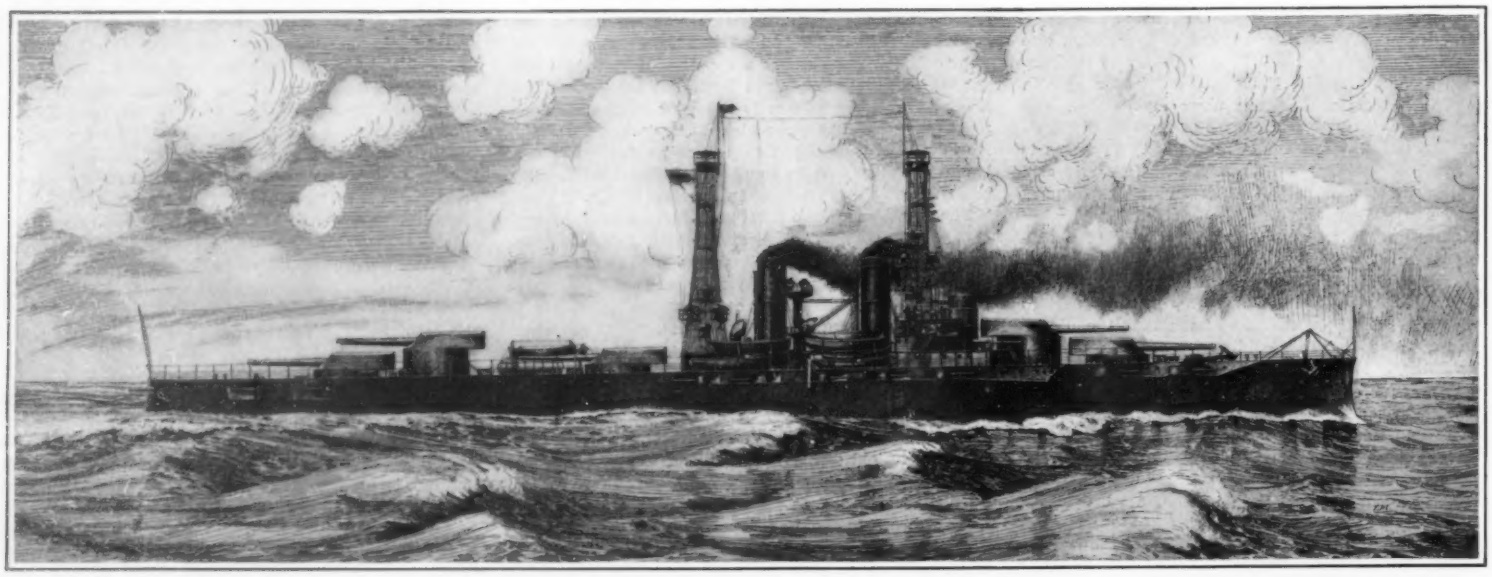


Cross-section showing torpedo battery on two decks, protected by side armor and three protective decks.

the second part of this article, the problem takes on an entirely different aspect. It is quite conceivable that in a 16,000-ton destroyer (or torpedo-battleship, if you will) the weight which in a "Connecticut" would be put into guns, turrets and casemates, might be so effectively worked up into a system of heavy protective decks, bow protection and water-line belting, that the ship would have a good fighting chance to run the gauntlet of shell fire from a modern dreadnought, and draw near enough to discharge her broadside of 21-inch, 40-knot torpedoes, before she was sent to the bottom, as she ultimately would be.

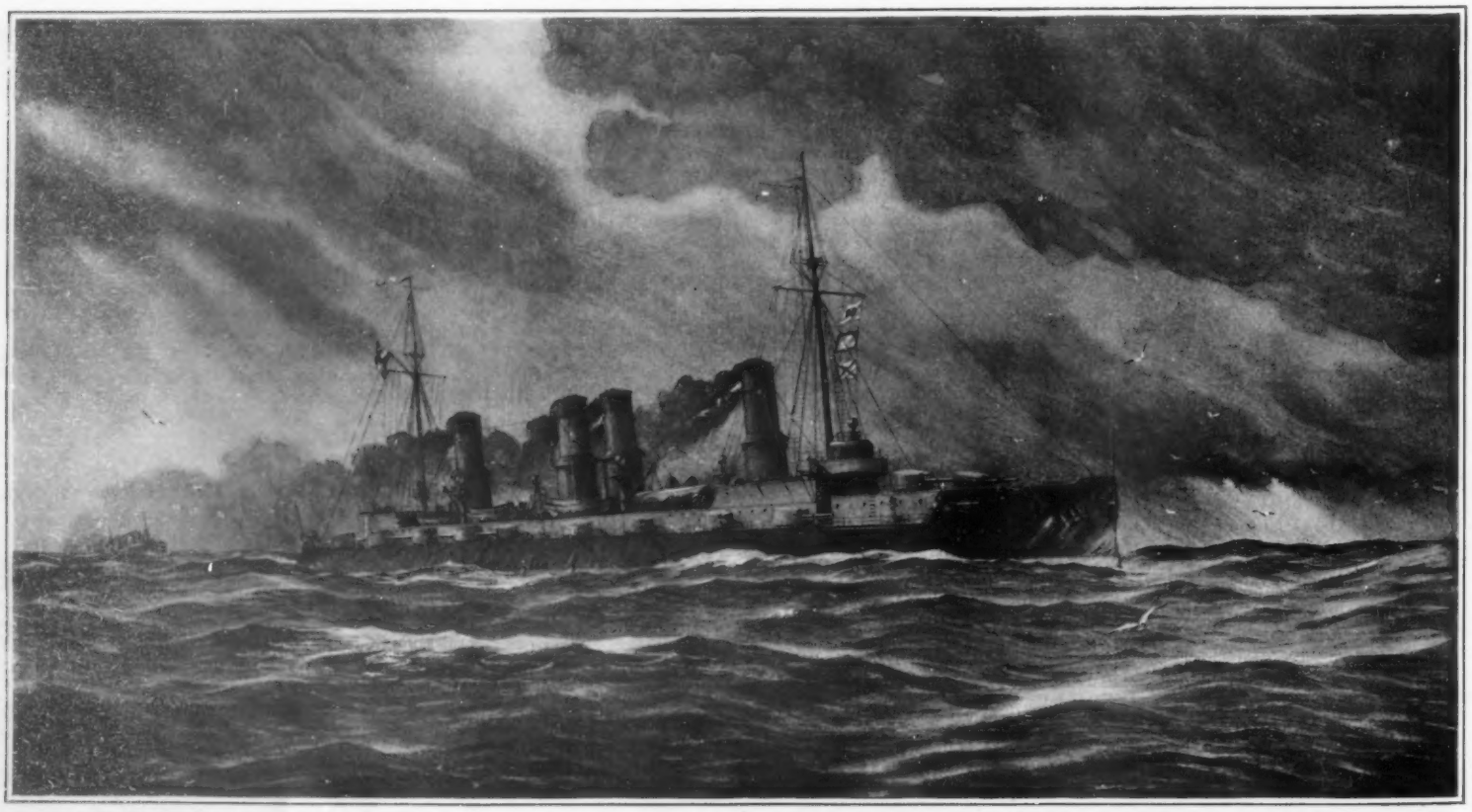
The chances of such a vessel getting within torpedo range, however, have been greatly reduced by the introduction of 13½ and 14-inch guns as the main armament of battleships. The 14-inch gun, of which there are ten, will form the main armament of the two mighty ships, "New York" and "Texas," the construction of which is about to be undertaken at the New York Navy Yard, Brooklyn, and at the yards of the Newport News Shipbuilding and Drydock Com-

(Continued on page 416.)



Length, 565 feet. **Beam,** 95 feet 2⅝ inches. **Displacement,** 27,000 tons. **Coal and oil,** 2,850 tons. **Armor:** Belt, 9 inches to 12 inches; gun positions, 12 inches. **Armament:** Ten 14-inch 45-caliber guns; twenty-one 5-inch 50-caliber guns. **Torpedo tubes,** four submerged.

A 27,000-ton big-gun battleship ("New York" and "Texas").



Length, 492 feet. **Beam,** 75.5 feet. **Speed,** 24 knots. **Radius of action** at 18 knots, 4,000 miles. **Armament,** thirty under-water torpedo discharge tubes; 22 4.7 R. F. guns.

A 15,250-ton torpedo battleship. (Italian design.)

BATTLESHIP VERSUS DESTROYER

A New Aeroplane Passenger-carrying Record

Louis Breguet's Feat of Transporting 11 People 3 Miles Across Country. Description of the Machine

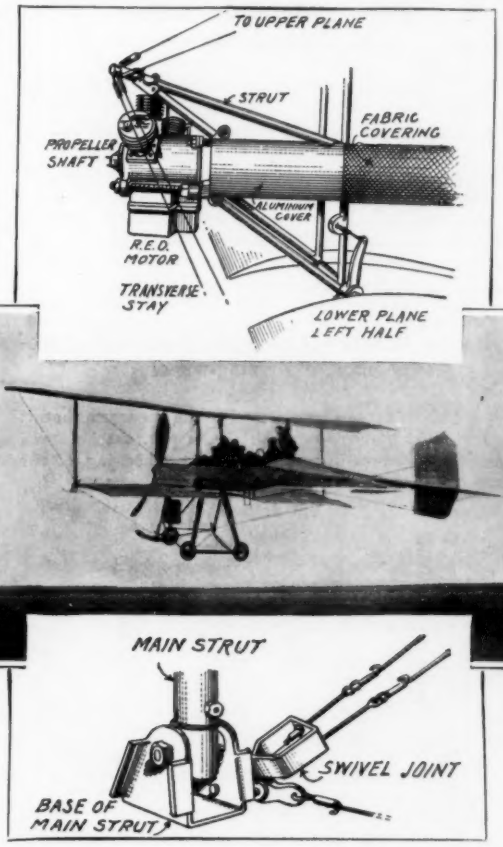
SCARCELY a month elapsed ere the wonderful record of Le Martin, in his Blériot monoplane, in which he carried nine passengers, was greatly surpassed by another French pioneer, M. Breguet. On March 23rd, above the aerodrome of La Breyelle, at Douai, M. Breguet made a flight with eleven passengers, or, including himself, with twelve people in his biplane. Rising into the air without any perceptible difficulty, he made a straight-line flight of 5 kilometers (3.1 miles) at a speed of 90 kilometers (55.9 miles) an hour. The weight of the machine complete was 600 kilogrammes (1,322¾ pounds), and the live load transported was the same, so that a total weight of 2,645½ pounds was carried through the air at express train speed for a distance of over three miles. The average weight of the passengers carried was 50 kilogrammes (110¼ pounds). We believe that this is the first time on record when the live load carried has equaled the complete weight of the machine.

With this demonstration of the possibility of carrying a dozen or more passengers, there is no doubt but that aeroplane flights with several people for pleasure purposes will come into vogue early this summer. The day after Breguet made his great passenger-carrying flight, Roger Sommer got off the ground in his biplane with twelve passengers, but he succeeded in making little more than a jump.

M. Louis Breguet is one of the foremost French aeroplane experimenters. He has been at work at Douai for a number of years past, and has gradually developed one of the most perfect aeroplanes thus far constructed. Previous to his recent experiments he built a helicopter while working in conjunction with M. Richet in 1907. This machine successfully lifted a total weight of 1,100 pounds.

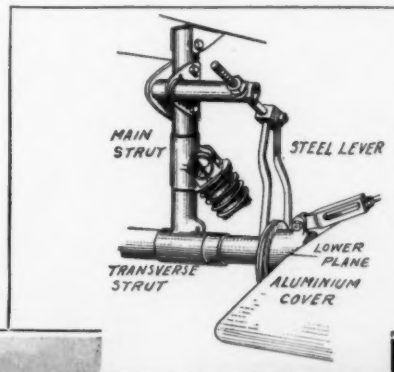
As for the Breguet biplane, its fine lines and simplicity of construction are the result of patient and diligent study and experiment. From the start this machine has been remarkable for its great lifting power, and the wonderful steadiness with which it makes long glides after the motor has been stopped. Only a year ago, on April 8th, 1910, Breguet carried three passengers in an excellent flight at Douai, and attracted the attention of the entire aviation world. Later, at Rouen, Rheims, and other aviation meets, his biplane, driven by himself or by Bathiat, won many prizes for passenger carrying, and showed itself to be extremely speedy and reliable. During the French army maneuvers Breguet carried Captain Madiot and made some excellent reconnoitering flights. On September 1st last Breguet carried four passengers, making a total live load of 750 pounds. Only a few weeks later he carried five passengers and made an excellent flight, the total live load being 860 pounds. These performances of passenger carrying were unequaled until early in the present year, when they were beaten by Sommer and Blériot. On December 31st, 1910, Breguet, while competing for the Michelin Cup, made a flight of 205 miles at high speed.

M. Breguet is one of the French constructors who favor steel tubing in place of wood. The front end of the body of the Breguet biplane is square in cross section, the four corners consisting of four seamless steel tubes, threaded at their front ends. The two lower tubes extend forward and pass through lugs at the front as well as at the rear of the R.E.P. motor. The upper tubes of the body pass through lugs at the rear upper part of the motor crank case. This simple method of attaching the motor securely to the machine is excellent, because it distributes the pull of the propeller throughout the entire body framework. The body is covered with aluminium at the front and with cloth at the rear. There are two vertical struts connecting the upper and lower planes in the center of the machine, and about one-third of the way back from the front edge of the planes. Inclined braces of steel tubing extend upward from the bases of these struts to the front end of the body, and other inclined struts extend forward over the motor and are connected by guys to the upper surface and to the chassis below the lower one, as shown in the diagram above the photograph of the biplane in flight. The planes of the biplane are built up upon steel tube longitudinals located about one-third of the way back from the front edge. U-shaped ribs of sheet aluminium are fastened to these by an ingenious elastic joint. In the case of the lower plane (which is in two halves), a connecting tube passes through these tubes and is securely fastened to them. Mounted upon this connecting tube is a lever which can be moved by adjusting nuts on a bolt extending from the end of the lever through a short tube that projects from one of the two vertical struts above mentioned. By adjusting this lever the wings can be set at a suitable angle. In a recent following-plane biplane, brought out by Breguet, he has arranged for the adjustment of the angle of incidence of the planes while in flight—an adjustment that was first brought out by M. Pelterie on his monoplane.



The biplane in flight, fully loaded.

The live load equalled the weight of the biplane, each being 1,322¾ pounds. The sketches show the mounting of the motor and of the end struts connecting the planes.



Breguet at the wheel of his biplane, showing 10 passengers.

The eleventh passenger, a boy, is hidden from view in the photograph. Sketch above shows arrangement for adjusting angle of incidence of the lower planes.

DETAILS OF THE BREGUET PASSENGER-CARRYING BIPLANE

The sketch below the photograph of the machine in flight shows the mounting of a vertical strut of the Breguet biplane. As can be seen, the strut is pivoted upon the cross pin of a sort of stirrup, so that it is capable of a slight movement back and forth. The double guys for bracing the planes are shown in this illustration. One of the main points of the Breguet biplane, however, is the use of steel rods in place of guy wires. In addition to the two vertical struts at the center of the machine, there are but two other struts, one near each end, as can be seen in the photograph. The use of so few struts and guys, as well as the adjustability of the planes, make this machine one of the speediest biplanes in existence. In addition to this, it holds the record for weight carrying, as detailed above. The section of the planes is an even curve having a thick, blunt front edge and narrowing to a fine edge at the rear. The upper plane is longer than the lower one, its spread being 43½ feet, as against 32½ of the lower plane. The width of the planes is 5½ feet, and the total supporting surface 409 square feet. The main feature of the Breguet biplane is the cruciform tail which is flexibly mounted at the end of the body in such a way that if it is hit beneath by a gust of wind it will give upward and tend to steer the machine in that direction, thus counteracting the tendency to dive that the machine would have if the tail were rigidly mounted. In this manner a considerable degree of automatic stability in a fore-and-aft direction is obtained. The transverse stability of the machine is maintained by warping the wings in the usual manner. The motors used by Breguet have been the Gnome, Renault, or R. E. P. One of the sketches shows the front end of the machine with an R. E. P. motor fitted. The military Breguet biplane, on account of its steel-tube construction, can be taken apart and packed for transport in half an hour.

For further particulars about the Breguet biplane we refer our readers to our new book on "Monoplanes and Biplanes," which has been specially written by Mr. Grover Cleveland Loening, M. A., and which will be off the press in two weeks' time.

The Gordon Bennett International Aviation Trophy

By Earle L. Ovington, Licensed Aviator

IF the French do not carry off the banner this year in the world's greatest aviation contest it will not be because they are not making elaborate and carefully planned preparations to do so. They have never quite recovered from the shock of surprise given them by Glenn Curtiss when he, an American aviator flying a machine of his own construction, invaded their midst and won the big event at the first international aviation meet, held at Rheims in 1909. On this occasion Curtiss, up to that time practically unknown abroad, surprised the aeronautical experts by beating the fast French monoplanes with a biplane. By winning the Gordon Bennett trophy in 1909, Curtiss brought the 1910 contest to America, and the race took place at Belmont Park last November. Again a surprise awaited the French, for in this case C. Grahame-White, an English aviator, proved the winner. To be sure, the French led until the last lap; but an unfortunate accident prevented Leblanc, their champion, from finishing a race in which he was leading. The French had one satisfaction, however, for Grahame-White used a French Blériot monoplane, although being himself a member of the English team, the trophy went to England. Consequently, on English soil—or, more correctly, *over* English soil—the contest will be fought this year, the date set being July 1st.

This double defeat has acted as a spur upon the French aeroplane makers, and great is the activity among them to produce racing machines, in the hope of bringing back to France the much-coveted and twice-lost Gordon Bennett trophy. A brief consideration of the most promising aeroplanes which are being built for the French

(Continued on page 417.)

Write to Handy Man

THE Editor of Handy Man's Workship is so pleased with the vote in favor of the Department that he has decided never to close the polls. He wants handy men to continue to send him their suggestions and criticism, whether favorable or not. Only one man has voted against the Department. The gist of his letter was published in the issue of April 1. The Editor is always glad to learn of new kinks and pays for them promptly, if they are available.

An Adjustable Rose Reamer

By C. S. Bourne

IN a general jobbing practice it often becomes necessary or desirable to ream holes that have been previously drilled a size a little smaller than the desired finished gage. Redrilling with a twist or flat drill may be near enough in some cases, while in others there may be required a driving or may be a

An adjustable rose reamer.

good running fit for a piece already turned. There may be a number of these holes to size correctly, or alike, and the nearest flute reamer available is a trifle small or large. Under the conditions it becomes a question of quickly making a tool near enough to the correct size to do the work satisfactorily.

The so-called "rose" reamer is a tool quickly made by turning a piece of tool steel to the correct size and length, and relieving it slightly from the cutting teeth back toward the shank. After rounding the end, file the teeth with a sharp half-round file and harden. I once made a modifications in the rose reamer like the sketch by making it slightly adjustable, where I had a number of holes to size with slight variations. With a hack saw I made a slot about one-half inch deep, and then by inserting a thin wedge in the end the very slight change needed was easily effected by driving it a little, thus springing the two sides apart sufficiently for the purpose.

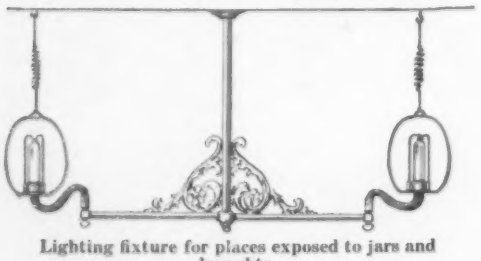
This plan may be a useful scheme to others in a like situation.

Light Fixture for a Shipping Room

By Albert Mayoh

THERE are many places, especially in shipping rooms, foundries and machine shops, where a brighter and more intense light is desirable, but is almost entirely precluded because of the liability of accident and the cost of replacement. To those who are meeting this problem, the accompanying sketch showing a device adopted by our "utility man" in the shipping room of a large city "public market" will be useful.

We have several lights, near the elevator, and the grocery chutes and near a revolving carrier chain



Lighting fixture for places exposed to jars and draughts.

(which we use for carrying the baskets from the cellar to the sidewalk for the teamsters) where we have had an unusually large number of broken mantles and chimneys. To lessen the breakage we have adopted the following device:

A metal ring is suspended from the ceiling by a steel wire, to which is attached a curtain spring. Upon the ring is a small plate with a hole large enough to receive the Welsbach burner. The burner is then placed on the mantle and used without a chimney. Thus the spring takes up all the vibration, and the rubber tube gives enough freedom for the burner to swing whenever it is struck.

We do not use the glass chimney on the burner, but burn the mantle unprotected and find that it lasts just as long if not longer than with the chimney and the light is fully as bright even when the light is in a draft, while the air no longer acts to break a chimney, but merely swings the support.

A Novel Pipe Wrench

By O. Ruehmer

AMONG the many uses to which old files may be put the following has one advantage, namely that if properly used it will not mark brass or copper pipes. Take an old 12-inch file, half round preferred, and grind

Pipe wrench made from a file.

the flat side fairly smooth, just enough to remove the points of the teeth for a short distance from the end. Next anneal the end and bend it into the shape shown in the sketch. The size of the curve will depend on the size of the pipe the wrench will take. However, a file bent as shown around an inch pipe will take three-quarters. At the back drill a hole, which is tapped for a long set screw, and your wrench is complete. As stated above, this wrench will hold brass or copper pipe securely without marking it.

How to Rebore a Crank-pin Hole in a Locomotive Driving-wheel

By H. D. C.

WHEN a crank pin has become so worn that it must be replaced with a new one, the hole will be found out of round, due to the knocking of the main rod.

There were some new pins to be set in the driving

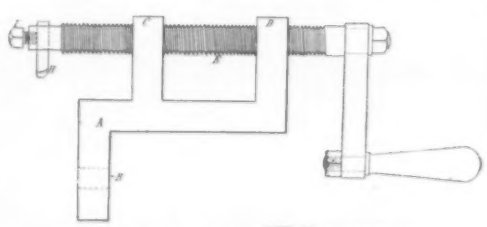


Fig. 1.—Tool for reboring crank-pin holes.

wheels of a locomotive, and when the holes were measured they were found to be out of round so that it would be impossible to make a driving fit. It is quite a task to remove the wheels from under an engine and take them to the machine shop to be rebored, and so after some hard thinking the following method was evolved: A tool was made as shown in Fig. 1. Angle plate *A* was made of machine steel. The face of angle was machined at *B*. A hole was then bored and chased through both ribs of the angle plate shown at *C* and *D*. The screw *E* was made of machine steel and was two inches in diameter chased to twenty threads per inch. By using a screw having this number of threads it was an easy matter to turn it while taking a cut through the bore of the wheel, as the wheel was of cast iron. There were two holes in the angle plate (*F* and *G*, Fig. 2). These holes served for clamping the device to the driving wheel.

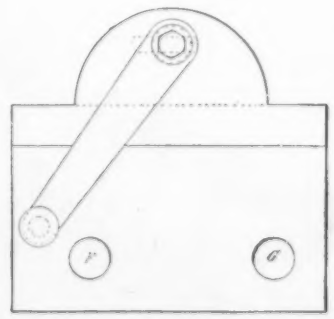


Fig. 2.—End view of the reboring tool.

The screw was run back so that it would clear the wheel, and the tool was placed in position, as shown, and held there by the means of a set screw *I*. When the device was clamped to the wheel the tool was adjusted out to take a cut through the wheel. The screw was revolved by means of the handle, and owing to the fact that the pitch was very fine the feed was so light the handle could be easily turned.

The hole when finished was round and straight and served as well as if done in the machine shops.

Removing a Broken Handle from an Ax Head

By W. D. Graves

WHEN an ax handle or a chair rung is broken much time is apt to be wasted, and serious damage is sometimes done, through misguided efforts to remove the end from the eye or hole; yet it is a simple matter if one goes at it rightly. There is not the

Removing a broken ax handle.

slightest occasion for heating in the one case nor for marring in the other. Bore a hole through the plug with a bit or drill small enough to insure against striking the sides of the original hole; then, with a narrow chisel, cut a slot from each of opposite sides of this hole to the outside of the material to be removed, as shown in the photograph. This will leave the plug in two separate parts, which, if they do not drop out of themselves, may be easily knocked out or split out with the chisel.

If the problem should happen to be that of a handle which is secured by an iron wedge, then a small hole drilled through, close to each side of the wedge will make an opening through which it may be punched out, and from which to chisel the slots as illustrated. In cases where metal is apt to be encountered it is best to use a twist drill for the boring, as such a drill works very well in wood and is not injured by moderate contact with metal, while a bit would be apt to be ruined.

Direct-Indirect Lighting Fixtures

By A. R. Van der Veer

LAST week's issue of the SCIENTIFIC AMERICAN had much to say on the subject of direct, indirect, and direct-indirect illumination. In the first case, the source of the light is not concealed, and is objectionable for the reason that it produces considerable glare. In the second case, the luminous source is entirely concealed and the room is illuminated by reflection from white walls. In the third case we have

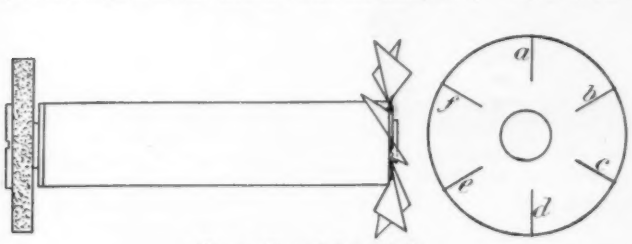
A handy man's direct-indirect lighting fixture.

a combination of both systems, which is generally considered the best system of illumination. The writer recently had occasion to study these various systems, and undertook to apply them in his own home. He was using in the library a particularly bad form of illumination. This consisted of an electric drop lamp, with a globe of frosted glass. The light source was so low in the room that the glare was extremely objectionable in the vicinity of the lamp, while remote parts of the room were very

badly lighted, even though the room was but twelve feet square. The effect was not greatly improved by using in addition an incandescent mantle on one of the wall gas fixtures. To remedy these conditions, the following scheme was carried out: The globe of the drop lamp was inverted and hung by means of brass chains from a hook in the ceiling. A 40-watt tungsten lamp was suspended within the globe, as shown in the accompanying illustration. The shape of the globe was such that a special form of clip had to be made to provide a hold for the chains. Three pieces of soft flat brass were bent to the shape indicated in the detailed view, so that each could be hooked over the rim and had a projecting portion which followed the curve of the glass below the rim. A set screw was threaded through this portion of the clip and was tightened up against the glass. Thus a very firm hold was provided in a simple manner. This fixture was suspended at a height of 6½ feet from the floor, so that it would easily clear the head of any one passing under it. The frosted exterior of the globe diffused the light, while the polished interior surface acted as a reflector, casting the light up against the white ceiling, whence it was reflected again to the room below. Thus in a single fixture, a combination of diffused, direct light and indirect light was obtained. The drop lamp previously used was fitted with a 16-candle-power carbon filament lamp, consuming 56 watts, whereas the tungsten lamp consumes but 40 watts, and is rated at about 35 candle-power. The tungsten lamp gives 25 hours of light for 10 cents, while the less brilliant carbon can be run for only 18 hours on 10 cents worth of current. The entire room is lighted up by the new fixture with a soft light, in which there are no very heavy shadows. One can read with comfort anywhere in the room, though, of course, the most intense light is to be found directly under the fixture.

Fan on Grinder Spindle

THE writer saw an ingenious little kink the other day while walking through a railroad shop. The operator of a grinder was troubled with the emery dust,



Fan on the grinder spindle.

but overcame the difficulty by fitting a fan on the grinder spindle. He took a piece of galvanized iron sheeting and laid it out as per sketch. After drilling a hole in the center and cutting it along the lines *a*, *b*, *c*, *d*, *e*, and *f*, he fitted the disk upon the spindle and twisted each section to form a fan. The pieces being ground were link bushings, and the table traveled in line with the emery wheel. The fan drew all the emery dust, etc., from the wheel, and blew it away at the back of machine.

Workshop Notes

Hardening Tool Steel.—When hardening tool steel, if extreme hardness is desired sprinkle some common table salt on the tool before placing it in the fire, and when the salt melts and runs over the steel it will act as a flux. When the steel has been brought to the required heat, plunge it in clean water. When cool the tool will be hard and free from scale and will not crack. Then draw it to the proper temperature. Steel treated in this manner will give good results.

Prevent Breaking of Center Drill.—The great trouble with combination center drills is that you have to feed them into the job slowly or you will break the point off. The fault, especially in small ones, is that the drill part does not cut large enough to clear itself, thus making it bind and very often break, and after breaking it is usualy so tight that 't is impossible to remove it except by annealing. All this trouble can be overcome by grinding the center drill with one lip a little longer than the other. The drill will then cut itself clear, and will cut faster, and if the point does happen to break, with a little rapping the piece will drop out, as the hole will be larger than the point of the drill.

Wire Spikes Used for Small Bolts.—Nothing is handier in the small work shop than an assortment of wire spikes from 4 inches to 10 inches or larger, an assortment of blank nuts to fit the spikes when threaded and a set of taps and dies. They can be used in many ways where extra strength is required by threading the ends, driving them through with a washer over the head, and tightening them up with a washer and nut. Where the work has to be made to be taken apart, holes must be bored first. With an assortment of spikes the right size can nearly always be found for the job without cutting, though a hack saw will add to the efficiency of the outfit. I have made the timer points for my gasoline engine out of 6-inch nails. I can make half a dozen of these in fifteen minutes at practically no expense. Before I found this out I paid $1.50 a pair for them.—ALEX. ROBERTSON.

Repairing a Hot-water Radiator.—Through neglect and carelessness I went away and let the water remain in my hot-water plant. I was gone for about a week, and when I got back I found the plant frozen up and one of the radiators burst. So I made enough fire in the boiler to melt the ice and drew the fire and let the water out of the pipes. I then repaired the crack in the radiator in the following manner, and it is holding water as well as a new radiator: I mixed litharge with glycerine to a stiff paste, and forced it into the crack with a putty knife or some similar instrument. After filling the crack I let it stand over night, and on starting the fire in the boiler in the morning, the water was, of course, cut off from the cracked radiator. As the water warmed up in the pipes, it heated the radiator, causing the paste to set. The water was then turned on in the radiator, and there were no signs of a leak. If this mixture is properly applied the job will last as long as the radiator. The one I repaired has been in service three years since the break.—H. D. CHAPMAN.

A Few Remarks Concerning Blue Printing.—To make a perfect print from patent office bristol board without recourse to tracing the drawing the writer has found the following scheme excellent: Place the bristol board as completed with face up in the frame of a blue-printing frame and upon this face a sheet of negative paper. Expose the required length of time and develop. With the dried negative a perfect blue line print can be made in the usual manner. To one who has tried to blue-print patent office bristol board direct it is known that the lines are blurred, due to the thickness of the paper. By placing negative paper as outlined above in contact with the ink a perfect negative results, which naturally produces a perfect blue line print. To make a beautiful blue, blue-print, with clear white lines, over expose the print until it is a hopeless case with the usual water wash, then bring it back by a dilute solution of hydrogen peroxide, about one to four. This can be applied with a brush outside of the wash tank or it may be poured directly upon the print in the wash tank. If the latter is done, however, every print must be treated in the same way, as peroxide added to a properly exposed print will bleach it.—J. F. O'BYRNE.

Cleaning Shellac Brushes.—A shellac brush is easily and readily cleaned in soap and water if it is taken in time and the work is done quickly, before the shellac has had time to set. Alcohol is generally used for this purpose.

Detecting Leaks in a Gasoline Tank.—The owner of an automobile has been running one for two years. The gasoline tank did not show any leaks that the eye could detect until quite lately, when he used lubricating oil with the gasoline mixed together. The leaks then were very easily detected, as the lubricating oil which came through with the gasoline would stand on the surfaces without evaporation. When only gasoline was used it would get through a very slight leak and evaporate so quickly that the eye could not detect it.

Making Gaskets Readily Removable.—To make a gasket for a cylinder head tight and yet permit it to be removed readily when desired without danger of tearing the surface of the gasket, rub on the surface of the gasket that comes in contact with the cylinder head black lead in a dry powder so that it gives quite a shine. Use the same black lead on the cylinder head surface. Black lead should be used on bolts or nuts that are removed occasionally. It allows you to turn them tighter when turned down and also to start them more easily when removed.

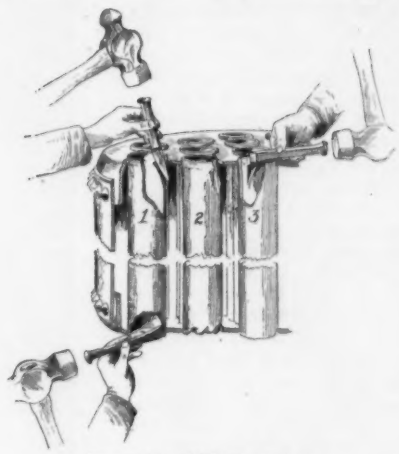
Holding Brass Pipe in a Vise.—When cutting threads on brass pipe it is often desirable not to scratch or bruise the brass pipe. The mechanic usually makes wooden jaws by taking two pieces of wood and boring a hole on the line where they are joined together. The pipe is then placed between the jaws in the half round holes and clamped tightly in the vise, which will not always hold securely enough when using the pipe die. A little powdered rosin put on the half round recesses of the wood jaws will grip the pipe sufficiently for the work.

Removing Old Boiler Tubes

By A. F. Bishop

ALMOST any mechanic can remove old tubes from a boiler if he understands the wrinkle.

A cape chisel is used first, as shown at 1 in the accompanying drawing, cutting through the tube just under the tube head and forcing the metal chip in



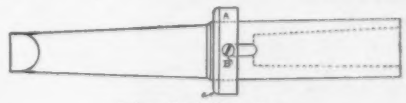
Removing old boiler tubes.

toward the center of the tube. Next use the flat chisel, as shown at 3, cutting out the small connection on the end of the tube just above the point where the cape chisel was used. The lower end of the tube does not need much chiseling; one cut with the flat chisel is about all.

The lower end is then battered in with hammer, also the upper end, as indicated in tube 2. Now the tube is ready to be lifted out by hand, which generally does not bother much.

A Handy Drill Socket

THE line cut shows a simple device that may be applied to an ordinary drill socket so that the drill may be quickly removed without stopping the drill press. The ring *A* is made a sliding fit on the socket as shown. The edge of the ring *A* is rounded as indicated at *C*. A screw *B* passes through one side of the ring *A*, and through the tang hole of the

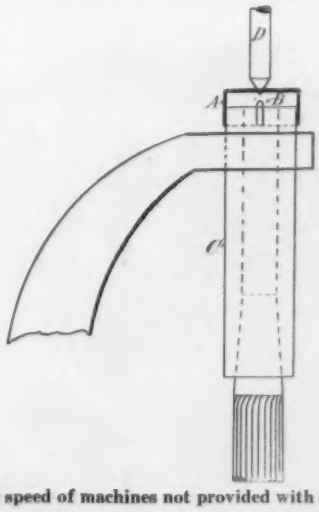


A handy drill socket.

socket and screws into the opposite side of the ring. When the drill is in place, and the machine is running, the drill can be easily removed by a light rap on the rounded edge of the ring. And when the drill has been removed another drill can be placed in position while the machine is in motion.

Taking Speed of Machines Not Provided With Centers

HAVING occasion to take the speed of a die sinker not provided with the usual centers, the writer made a brass shell, as shown at *A*, and slotted it at



Taking speed of machines not provided with centers.

four equally distant points, as shown at *B*. This was simply slipped on to the end of the spindle *C* of the machine and then the speed indicator *D* could be inserted in the countersink hole in the end of the shell. This little kink worked as well as if the center was in spindle.

Railroad Clearance and Curvature Car

THE new clearance car which is here illustrated has just been placed in service on the Pennsylvania Railroad lines east of Pittsburg and Erie. It was designed in the office of the engineer of maintenance of way, and is being run over every division as rapidly as possible in order to secure correct measurements of the distances from the track to projecting portions of station buildings, tunnels, bridges and other objects. It is also designed to indicate automatically, while moving on curves, the elevation of the rails and the degree of curvature.

The car, which is 54 feet 8¾ inches long over all, and 30 feet between truck centers, is built entirely of steel. At the front end of the car where the templets are located is a second floor at an elevation of 9 feet 8 inches above the top of the rail. Both floors are for use in taking measurements from the templets. The second floor is reached by steel stairways on each side of the main templet.

All measurements are taken at the center of the wheel truck, from which clearances are computed. The main templet, which is erected directly over the center of the truck, has a width of 10 feet between elevations of 2 feet and 12 feet above top of rail, exclusive of the fingers or feelers attached to the sides. From an elevation of 12 feet above top of rail, the templet recedes toward the middle of the car at an angle of 45 degrees, reducing with the width of the templet to 4 feet at the top, at an elevation of 15 feet above the top of the rail.

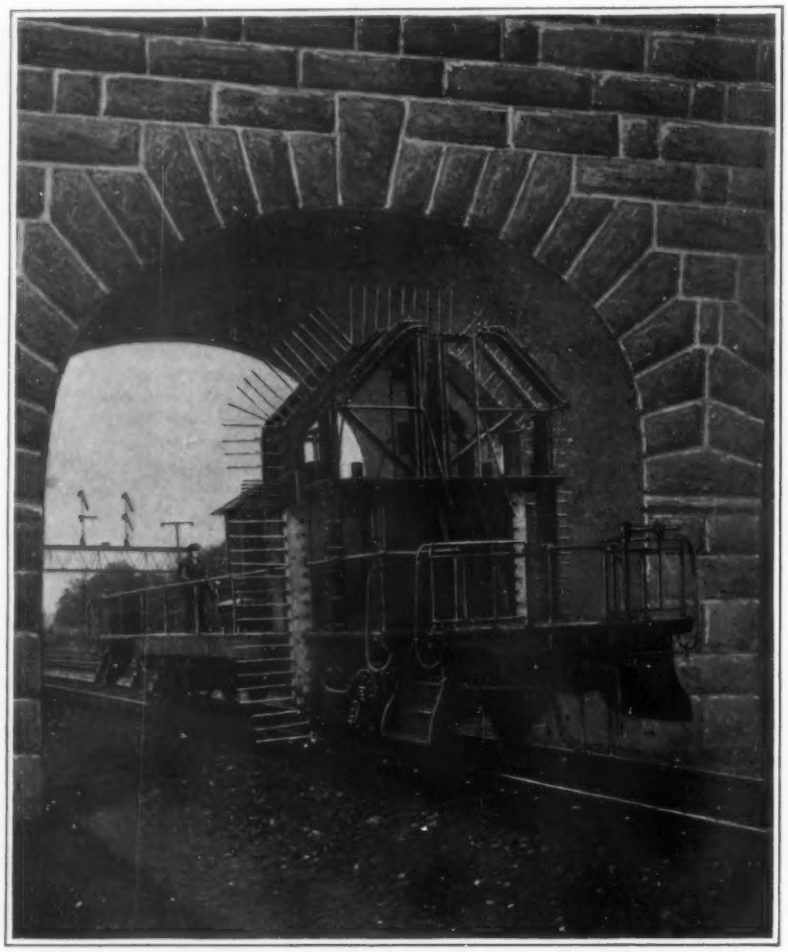
Immediately in front of the main templet is constructed an auxiliary templet, designed to measure overhead bridges, tunnels and other objects between elevations 17 feet and 20 above the top of the rail. This auxiliary templet has the same dimensions as that part of the main templet between elevations 12 feet and 15 feet. It is supported on a center shaft inclosed in an upright cylinder and is capable of being raised to a height of 18 feet by a crank and ratchet arrangement on the floor of the car.

Inclosed in steel cylindrical boxes with translucent glass fronts facing the templets is a series of electric lights which extend from the floor of the car on each side thereof to a height of 15 feet above top of rail. The well diffused light thus obtained makes it possible to take measurements both day and night, as well as in dark tunnels.

The fingers or feelers attached to the sides and the top of the templets are 2 feet long and are spaced 6 inches apart. They are hinged to the templets and held in the different positions by friction. Attached to the feelers and the side of the templet are graduated scales which indicate automatically the distance from the rim of the templet to a side or overhead object. In addition, a small board equipped with a set of feelers spaced one inch apart has been provided to measure cornices of roofs, of shelter sheds, or other irregular objects close to the track. This board is detachable and can be fastened to the side of the templet at any point desired. As the car passes over a curve, an attachment on the rear truck of the car indicates the degree of curvature on a scale inside of a cabinet, which has been erected in the middle of the car. In this cabinet is also an instrument consisting of a long pendulum, suspended vertically, which indicates automatically the elevation of one rail of the track over the other. The side of this cabinet facing the main templet has been provided with a plate glass window, which enables the operator of the car to read the degree of curvature, or the elevation of the rail at any time.

With all of the attachment working automatically, it is possible to take clearance measurements while the car is running at a speed of four miles per hour; this is necessary at times in order to keep out of the way of regular trains.

Though two men can operate the new clearance car, one taking the readings of the scales and the other recording them; where clearances are close and irregular it requires the services of three men.



The flexible fingers projecting from the frame come in contact with the surfaces of tunnels, bridges, platforms, etc., and automatically record their outline.

NEW STEEL CLEARANCE AND CURVATURE CAR

Armored Cars in the Mexican Revolution

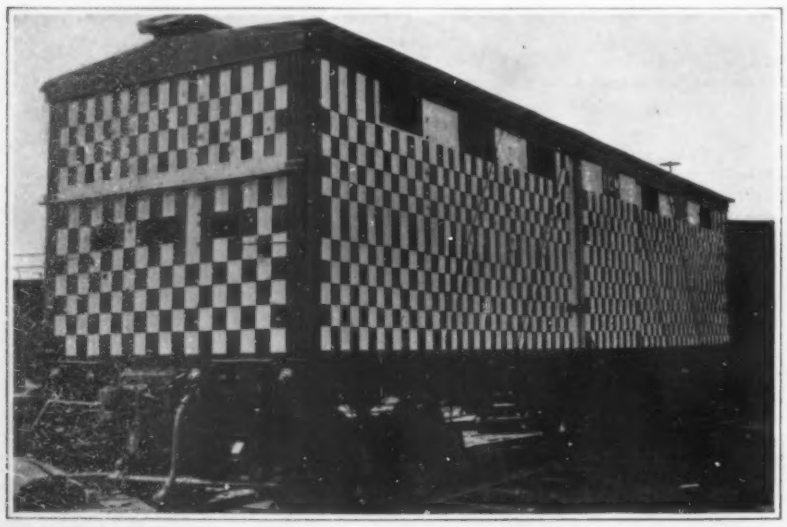
PROFITING by the example of the British in the Boer War in South Africa, the Mexican government has constructed three armored cars, equipped with machine guns and with facilities for housing sharpshooters. The cars are to be used on the northern branches of the National Railways of Mexico in putting down the revolution which, for a number of months, has been raging in that part of the republic.

The foundation for each of these cars is an ordinary box car of average size. This is sheathed inside with quarter-inch steel plates, a space of two inches being left between the wooden walls and the steel, and filled with sand. The cars are painted in four-inch squares of alternate black and white, and hence received the name of "checkerboard cars."

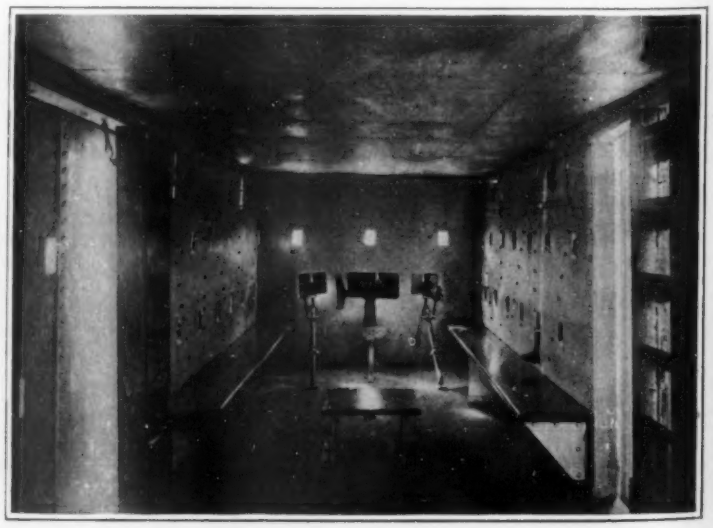
In each end special portholes are provided for three machine guns, while along the sides are holes for twenty rifles. These holes are made in the black squares, so that, at a distance, it is impossible to see them. Beneath the portholes, inside the car, are benches on which the riflemen stand to sight their rifles. When not in use for actual fighting, the benches are made into seats for the men by day and beds by night. A small kitchen, dishes, pantry, etc., are provided in the center of each car, so that the men may live for an indefinite time in their moving fortresses. Protected water tanks are also provided. One large machine and two small machine guns are planted at each end of each car, with portholes so constructed as to give considerable swing to the muzzles of the rapid-fire rifles. Special magazines are provided for cartridges for rifles and machine guns, while the side doors interlock with the steel-lined walls so perfectly as to offer no joint for the entrance of a stray bullet from the rifle of an enemy.

To draw these cars, a steel-sheathed engine is being prepared in Mexico city. This engine will be small, but of the regular passenger size in use on most railroads a few years ago. Not only will the cab, boiler, cylinders and other vital parts of this engine be pro-

(Continued on page 418.)



Exterior of the Mexican armored car to be used against the insurrectos in the present rebellion.



Interior of the steel sheathed car, showing the machine guns and the benches on which the sharpshooters stand.

FIGHTING MEXICAN REBELS BY RAIL

The Inventor's Department

Simple Patent Law; Patent Office News; Inventions New and Interesting

Some New Forms of Fuses for Explosive Shells

THE problem which has to be solved in designing a thoroughly efficient explosive shell is somewhat complex. It is not enough to merely provide devices which will cause the shell to explode on impact. The shot must be built with safety features which will prevent its premature explosion in transport or otherwise. And these safety appliances must be absolutely reliable, yet simple, if possible automatic in working, or if they require special setting, this operation must be rapid and straightforward.

Our illustrations show three examples of fuses, which are the subjects of patents recently issued in this country and assigned to the great German Krupp Company.

The first of these, an invention of L. Abendroth (U. S. Patent 988,846) is shown in Fig. 1 of our illustration.

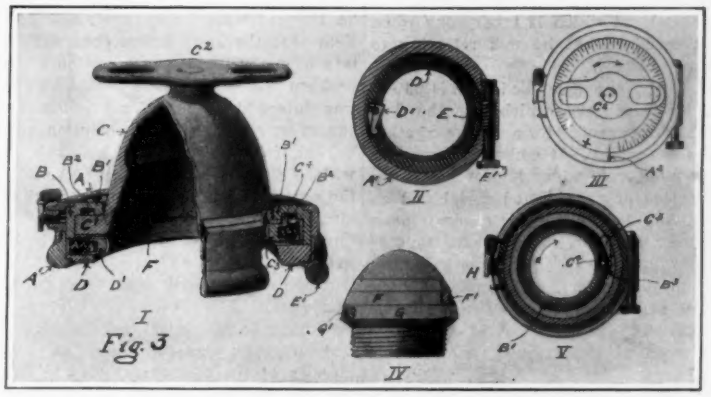
The fuse consists of a hollow slightly tapering cylindrical body *A*, containing within its central cavity a conical bolt *B* in which the primer *C* (indicated in dotted lines in Fig. 1 *I*) is lodged. Extending around the periphery of the bolt *B* is a helical groove, and at the center of the lower face is a recess in which a ball *G* is lodged when the fuse is not actually in operation. In this transport-position of the fuse the primer bolt *B* is secured against forward movement in the fuse body *A* by means of the two-armed latch FF^1. This latch is pivoted in a recess in the wall of the fuse-body *A*, and engages with its arm F^1 in a notch in the primer bolt. The latch is of such shape that when it is in the withdrawn position (as shown in Fig. 1 *IV*) all the parts of the latch are out of the path of movement of the bolt *B*. The weight of the latch is distributed in such a manner about its pivot that the force created by the rotation of the projectile is incapable of withdrawing the latch.

The ball *G* is held in place by a light leaf-spring *H*. When the shot is fired, the inertia of the ball *G* causes it to lag behind, and, overcoming the slight force of the spring *A*, it passes from the central recess into the helical groove, pursuing its path outward and forward under the action of the centrifugal force due to the rotation of the shot. Thus the ball finally reaches the latch FF^1, opens it, and passes out into a recess in the wall of the fuse, as shown in Fig. 1 *IV*. The bolt *B* is now free to move forward in the cavity of the fuse, and when impact occurs, the firing pin D^1 is forced into the primer *C*, whose explosion is communicated to the powder body *E* through the igniting channel B^4 which extends axially through the bolt *B*.

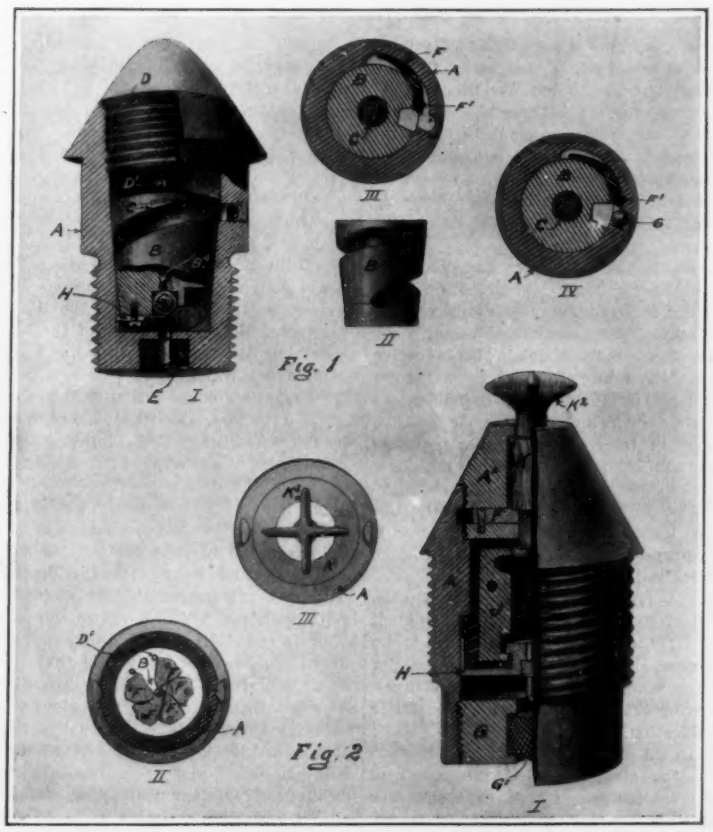
In our second figure is shown a fuse invented by Wieser and Schwartz (U. S. Patent 988,610). The several parts are represented in the transport-position. The primer is located at G^1 in the base *G* of the fuse. Immediately above it is the firing pin, mounted in a carriage *H*, which is pressed downward by a helical spring, but prevented from giving way to this pressure, and thus striking the primer, by the lever *J* whose lower extremity carries a shoulder engaging a corresponding shoulder upon the carriage of the firing pin. The opposite arm of lever *J* is provided with another shoulder or jaw, which abuts against a disk formed at the lower extremity of the shank *K*. This shank *K* terminates in a head K^2 which protrudes from the front end of the fuse. In the transport-position of the fuse the shank *K* is held in place by the retaining plates *F* (shown in detail in Fig. 2 *II*). These are pivoted in such manner that when the fuse is in rapid rotation, they tend to be deflected outward, clear of the shoulder of shank *K*. In the transport-position any accidental displacement of the retaining plates *F* is prevented by a stop D^1, which is inserted loosely, and falls back by its inertia when the shell is fired. The retaining plates *F* then swing outward, clearing the path of shank *K*, and when the shell meets an obstacle this shank is pushed in, levers *J* open at their rear end through centrifugal action, carriage *H* is released, and the firing pin is driven into the primer G^1.

The two fuses described thus far are designed to operate automatically at impact. The last case here illustrated is an example of a "time fuse," which is set, before firing, to explode after a predetermined lapse of time. The aim of the inventor (U. Wilck, U. S. Patent 988,750) here is to provide a mechanism by which the setting can be effected quickly and easily, without necessity of minute attention to exact manipulation.

The fuse carries a conical head *G* (shown in Fig. 3 *IV*), provided with a composition ring *F* notched at F^3. In setting the fuse this ring must be turned through a definite angle corresponding to the particular time selected for the firing of the fuse, and the invention illustrated is a key designed for the express purpose of effecting this setting by a simple turn of the hand. The structure of the device is somewhat intricate. A cap *C* is provided with a handle C^2 and a flange C^1. This latter fits into a space provided for it within a housing AA^1, which also holds an annular ring *B* above the flange C^1, and another ring *D* beneath that flange. An annular spring *F* is interposed between C^1 and *D*, tending to force them apart, and thus pressing flange C^1 up against ring *B*. The purpose of this is to enable the operator, when desired, to rotate the ring *B* by turning the cap *C*, the two moving together owing to friction and the pressure of spring *F*. The flange C^1 of cap *C* is provided at one portion of its inner circumference with a spring latch C^3 shown in section on the right hand side of Fig. 3 *I*, and in plan in Fig. 3 *V*. This latch has a lug C^4 projecting upward through an opening in the upper face of the flange C^1, and extending into an annular groove B^2 formed in the lower face of ring *B*, the inner flange of this groove having at one point on its circumference a stop B^3, shown in Fig. 3 *V*. When the fuse base *G* is inserted into the key, so long as the latch C^3 does not register with notch F^3, that latch is forced back, and the stop C^4 is pushed clear of stop B^3, so that cap *C* with latch C^4 is free to be rotated past stop B^3. On the other hand, once latch C^3 has engaged notch F^3, stop B^3 becomes effective in limiting the advance of the cap C^3 with its latch C^3. The ring *D* is provided with a latch D^1 to register with notch G^1 on the body of the fuse-head *G*.



Key for setting a time fuse.



Two forms of impact fuses.

The course of operation in moving the key is as follows: The thumbscrew *H* is loosened, thereby releasing ring *B* from casing *A*, and allowing it to turn therein freely. The handle C^2 is now turned, carrying with it the caps *C* and by friction also the ring *B*, until the fiducial mark A_2 (Fig. 3 *III*) lies opposite the desired division of scale B^4 which appears on the upper face of ring *B*, as shown in Fig. 3 *III*. The effect of this is to place stop B^2 at a definite angular distance from latch D^1, the ring *D* with latch D^1 being held stationary by the wormgear *E* during the manipulation of cap *C* just described. The thumbscrew *H* is now tightened, so as to permanently hold ring *B* in the position which has thus been given it, relative to the housing AA^1. Any correction of the burning length that may be required is made by turning the worm *J*. The key is now set for a time fuse corresponding to the particular division on the scale B^4 which has been brought opposite to the fiducial mark A^2, and is ready to be applied to the fuse-head *G*. Such application will not in general bring either of the latches C^3 or D^1 opposite the corresponding notch F^3 or G^1, but upon rotating the cap in the direction indicated by the arrow in Fig. 3 *III* and 3 *II* obviously the latch D^1 must fall into its notch G^1 in the fuse base *G* before one revolution has been completed. As soon as this has taken place the setting member *D*, the housing AA^1 and the ring *B* remain stationary. The latch C^3 must also enter into engagement with the corresponding notch F^3 during the first rotation of the cap *C*, and it must do so also in the case that it has not yet reached its notch F^3 when the latch D^1 enters the notch G^1. For example, the cap *C* can overcome the friction produced by the spring *F* between the flange C^1 of the cap and the flange B^1 of the ring *B* and can further be turned relatively to the ring *B*, the housing AA^1 and the ring *D*; furthermore, as long as the latch C^3 has not entered the notch F^3, the stop C^4 is in such position that it can not hit the stop B^3 when the cap *C* is turned relatively to the ring *B*. The cap *C* can not, therefore, be prematurely fixed in position through abutment of the stops B^3, C^4. After the latch C^3 has entered the notch F^3 the adjustment of ring *F* commences when the cap is turned farther in the direction indicated above. The turning movement of the cap *C* is continued until the stop C^4 hits the stop B^3, the former having reached its effective position relatively to the latter when the latch C^3 entered the notch F^3. From the moment C^4 hits B^3 the cap *C* is prevented from further rotation. The fuse has then obtained the desired adjustment, as the notches G^1 F^3 have now an angular distance from each other corresponding to the angular distance of the latch D^1 from the stop B^3, which distance was definitely fixed in the setting of the key as described above.

An Important Patent Decision

Marconi and Marconi's Wireless Telegraph Company, Limited, versus The British Radio Telegraph and Telephone Company, Limited.

THIS action was brought by Mr. Marconi and Marconi's Wireless Telegraph Company, Limited, to restrain the British Radio Telegraph and Telephone Company, Limited, from infringing the plaintiff's patent, No. 7,777 of 1900, and two other patents, but at the commencement of the proceedings it was agreed between the parties to confine the present case to the principal patent, as the apparatus covered by the other patents could not be usefully employed without that of the principal patent.

The plaintiffs claimed that the defendants had manufactured and sold, and were offering for sale, apparatus infringing their patent No. 7,777 of 1900, and asked for an injunction, damages, delivery up of infringing apparatus, and costs.

The defendants contended that they had not infringed the patent and that the patent was not valid, and in support of their contention cited numerous documents and called no less than seven witnesses.

In support of their contention of non-infringement the defendants argued that a two-coil transformer was an essential feature of the invention, that they were using a one-coil or auto-transformer, and that an auto-transformer was not a known equivalent of a transformer at the date of the patent. Further, they argued that if the auto-transformer they were using was an infringement they might instead use a single coil with an equal number of turns in each circuit which would not even be an auto-transformer, and, therefore, could not infringe.

In support of their contention of invalidity the defendants relied upon the following patents:

No. 8,575 of 1891, granted to Nikola Tesla.

No. 20,981 of 1896, granted to Nikola Tesla.

No. 11,575 of 1897, granted to Oliver Lodge.

No. 18,644 of 1897, granted to Oliver Lodge.

No. 29,505 of 1897, granted to Oliver Lodge.

No. 525 of 1898, granted to Silvanus Thompson.

No. 1,862 of 1899, granted to Ferdinand Braun.

No. 22,020 of 1899, granted to Ferdinand Braun.

And upon numerous papers and articles by Tesla, Oudin, Lodge, Evershed, Fleming, Brown, Fessenden and Blondin, published in the *Journal of the Institution of Electrical Engineers, L'Electricien, The Electrician, Proceedings of the National Electric Light Association, Comptes Rendus, Electrical World, Electrical Review* and *L'Eclairage Electrique*. The defendants argued that all these specifications and publications anticipated the patent, and if they did not anticipate it that they deprived it of subject matter.

As the case developed the defendants further contended that the patent did not give sufficient directions how the invention was to be carried into effect, and yet at a later stage they endeavored to read all the necessary information into Braun's patent No. 1,862 of 1899.

JUDGMENT.

(Considerably Abridged.)

Before going into the question of the infringement and validity of patent No. 7,777 of 1900, it will be convenient to say a few words about wireless telegraphy generally, and the problems which its practical application has involved, as only in this way can a proper conclusion be arrived at.

Wireless telegraphy in the sense here used operates by disturbances in the ether produced by the sudden discharge of a condenser, and in this respect is entirely different from magnetic induction telegraphy. Moreover, the effect produced on the receiver falls off in the latter case, as the cube of the distance from the transmitter, and in the former case only as the square of the distance, from which it follows that the utilization of these disturbances for conveying signals must be far more efficient than the utilization of lines of magnetic force.

Henry first noticed that the discharge from a condenser was oscillatory. Kelvin and Helmholtz established the relation between the frequency of the discharge and the resistance, capacity and inductance of the circuit. Clerk Maxwell showed that the oscillatory discharge of a condenser must give rise to a disturbance in the ether traveling with the velocity of light. Hertz supplied the experimental verification of Clerk Maxwell's theory, and produced the well-known Hertz radiator and resonator, the latter having a minute spark gap. Branly and Lodge produced the coherer, which, substituted for the minute spark gap of Hertz's resonator, made a much more sensitive receiver. In 1892 Crookes first suggested the utilization of Hertz's waves for wireless telegraphy, and in 1894, the year after Hertz's death, Lodge gave his famous lecture on "The Work of Hertz." In this lecture Lodge gave a very clear and complete account of the knowledge of Hertzian waves at that date, he pointed out the necessity for a persistent train of waves in order to obtain selectivity, and stated that conspicuous energy of radiation and persistent oscillation were incompatible —a statement which is true to-day when we remember that he was referring to a single circuit.

In 1896 Marconi applied for his patent No. 12,039 of 1896, which was the first patent ever granted for a system of ether wave telegraphy. It embodied, among a large number of minor improvements, the utilization of an elevated aerial and an earth, but had a number of drawbacks. Not only was there the drawback, pointed out by Lodge, that being a good radiator the aerial could not be a good oscillator, but it also suffered from the limitation of capacity and potential of the aerial and therefore of the energy which could be utilized.

In 1897 Lodge applied for his patent No. 11,575 of 1897, in which he employed an inductance with a large capacity aerial in order to prolong the train of waves and improve selectivity. He thus made a compromise, sacrificing the radiating in order to improve the oscillating properties of his aerial. In other respects his system resembled Marconi's. His aerial was vertical and not horizontal, and he says it may be earthed if desired, and he, too, uses a coherer of metal filings with a mechanical decohering arrangement.

Later, in the same year, Lodge applied for another patent, No. 29,505 of 1897, and the following year Silvanus Thompson applied for patent No. 525 of 1898. Both these patents relate to inductive telegraphy, and neither of them throws any light on the difficulties incident to utilizing the principle of resonance in a system of telegraphy by ether waves.

Marconi also applied for patents Nos. 12,326 of 1898, 6,892 of 1899, and 25,186 of 1899, all of which refer to the use of a transformer in the receiver for the purpose of increasing the voltage applied to the coherer.

It is true that Braun's patent No. 1,862 of 1899 preceded Marconi's patent No. 7,777 of 1900, but as there is no evidence that it was put into practice I have now mentioned all that is necessary for the interpretation of the latter specification.

Marconi commences his specification with the statement that the object of his invention is to increase the efficiency and to secure selectivity. He obviously refers to the difficulty pointed out by Lodge, namely, that you cannot have your circuit doing two incompatible things, however desirable, at the same time, and he says in effect: Take two circuits and let one do one of the things and the other do the other. For this purpose he employs a closed oscillating circuit coupled to an open radiating or absorbing circuit and adjusts all four circuits to have the same time period.

The interpretation I have put on the patent seems to me after careful consideration the true and indeed the only possible interpretation, but before leaving the subject I must mention the matter of coupling upon which considerable stress was laid at the trial. It was contended that loose coupling was essential to success, that no direction as to coupling is given, and that in one out of the nine examples given the coupling is not very loose. In my opinion the direction to couple loosely is impliedly if not expressly given in the specification.

It is not disputed that the invention does get over the difficulties it was designed to meet. It produced a persistent train of waves, increased the available energy, doubled at once the distance of communication, and secured selectivity. The utility of the invention cannot be doubted.

I propose next to consider whether the invention was anticipated by Braun's patent No. 1,862 of 1899. Braun's patent involves many difficulties, and he was evidently unacquainted with what Marconi and Lodge had already done. The essential feature of Braun's invention is the utilization of lower frequencies than he thought were being used, and it is clear that the specification does not contain even the remotest suggestion of the problem which Marconi's patent of 1900 was intended to solve, much less any suggestion bearing on its solution.

That I am right in this conclusion will be further evident when I consider the objection founded on want of subject matter. In considering this plea it is important to remember that two circuits in the receiver was no novelty. Lodge had two circuits in his 1897 patent. He was an engineer of first-rate ability endeavoring to get over the difficulty he had himself explained. He had two circuits at his receiving end, and in a way, at his transmitting end also, and yet he failed to see that if he utilized the principle of resonance as between those two circuits the problem would be solved. Marconi had two circuits in his 1898 patent and did not tune them. In the transformers of Tesla and Oudin rough tuning was done to overcome the disadvantage of comparatively loose coupling, but this was only with the object of raising the voltage, and is a very different thing from deliberately loose coupling and tuning two circuits together with the object of producing a long train of waves and securing the full benefit of resonance between the receiver and transmitter. In the literature quoted there is no trace of the idea underlying Marconi's invenion, and not a single suggestion from which a competent engineer could arrive at this idea. I hold, therefore, that the plea of want of subject matter entirely fails.

The only other plea of invalidity is based on the prior grant of Braun's patent No. 22,020 of 1899. This patent is similar to the previous one, with the addition of an earthed aerial. He says nothing of tuning, and the specification contains a passage which in my opinion is inconsistent with the two circuits being intended to be tuned together. I cannot see how it can be said that this patent contains a grant of the invention described in Marconi's 1900 patent.

Having come to the conclusion that Marconi's 1900 patent is a good and valid patent, I must now consider the question of infringement. The defendants' transmitter contains two circuits, one a closed circuit which is a good conserver of energy and a persistent oscillator, and the other an open circuit which is a good radiator. These circuits are intended to be tuned together and contain adjustable devices for that purpose. They are also linked together in such a way that the oscillations in the closed circuit will gradually build up and maintain in the open circuit like oscillations, thus radiating a long train of waves. Similarly, the receiver contains two tunable circuits linked together. It appears, therefore, that the defendants' apparatus contains all the essential features protected by Marconi's 1900 patent.

It is contended that an auto-transformer such as the defendants are using was not a known equivalent of a transformer at the date of the patent, and further, that they might use an inductive shunt which would not be a transformer at all. I cannot conceive, however, that an electrical engineer, in, say, 1899, would have had any doubt that what could be done by a two-coil air core transformer could also be done by an air core auto-transformer, and this even if arranged one to one, although an inductive shunt had never been used as a transformer before. In my opinion, however, the use of a two-coil instrument is not an essential feature of Marconi's invention at all, and it is a matter of indifference whether a transformer or an auto-transformer be used.

Being of opinion that every claiming clause of Marconi's patent of 1900 is a claim for an entirely novel combination producing an entirely new and useful result, and that the use of a two-coil transformer is no essential part of his invention, I hold that the defendants, who in my opinion have taken all the essential parts of the invention, are infringers, notwithstanding that they have substituted an auto-transformer for a transformer in the combination claimed, and notwithstanding that the use of an auto-transformer with an air core for any such purpose as that for which Marconi has used the transformer may have been new.

The action, therefore, in my opinion, succeeds.

The plaintiffs were granted a certificate of validity of their patent and an injunction, costs and damages against the defendants.

Samuel Loyd

IN the death of Samuel Loyd there has passed away an inventor who must ever stand as a type in his peculiar way. To him we owe such puzzles as "Pigs in Clover," "Fifteen Block," "Donkey" and "Get Off the Earth," nearly all of which were sold in enormous quantities. Mr. Loyd was born at Philadelphia seventy years ago. Although he was educated as a civil engineer and was a graduate of Heidelberg, where he studied languages and mathematics, he seems from a very early age to have devoted himself almost entirely to the invention of puzzles. He was only twenty years of age when his famous "Donkey" puzzle was invented. This was probably his most successful invention, no less than one billion "Donkey" puzzles having been sold. "Pigs in Clover" was almost equally well known, but did not make quite so much money. Puzzle making with Mr. Loyd was a serious occupation. He is reported to have said: "I always treated and considered puzzles from an educational standpoint, for the reason that they constitute a species of mental gymnastics which sharpens the wits, clears the fog and cobwebs from the brain, and schools the mind to concentrate properly. Comparatively few people know how to think properly. As a school for mechanical ingenuity, for stirring up the gray matter in the brain, puzzle practice stands unique and alone.

"We see how the average boy, who abhors square root or algebra, will find delight in working out puzzles which

involve identically the same principles. It makes one think that millions of earnest students who would really have loved to learn have been abandoned as incorrigible blockheads because those who had charge of their education did not know how to interest them in their studies. An aversion to figures and a desire to forget all about mathematics as soon as he leaves school is almost universal, and yet if the subject had been taught in a more congenial way the mathematical and inventive bumps might have developed in a way to astonish the family phrenologist."

Mr. Loyd took his greatest delight in working out a puzzle from its scientific basis and then so concealing its foundation as to make it imperceptible to the public.

Hundreds of chess problems were turned out by Sam Loyd, whose first prize for a maker of these was taken when he was eleven years old. He was the author of "Chess Strategy," one of the most popular works on the game. Turning to the mechanical field, he invented such puzzles as the chair puzzle and the star puzzle, almost impossible of solution.

Mr. Loyd was for some years chess editor of the SCIENTIFIC AMERICAN. He was tall, rather spare, and had very quiet manners. At the time of his death he was puzzle editor of the *Woman's Home Companion*.

Notes for Inventors

Henry W. Johnson.—Henry W. Johnson died on April 7th in Lynn, Mass., at the age of seventy-one. He is said to have been the inventor of the shoe button now everywhere in use.

"Babbitting."—The name of Isaac Babbitt is generally associated with the anti-friction metal which bears his name, but his greatest invention was not the "babbitt metal," but the accompanying process of using such a metal for the bearings of machines, or "babbitting." This process has had the widest influence on the development of high-speed machinery. Isaac Babbitt was an American, born in Taunton, Mass., July 26th, 1799, died May 26th, 1862. As a boy he was apprenticed to the goldsmiths' trade. In 1824 he founded the manufacture of britannia ware in the United States. In 1839 he discovered "babbitt" metal. The proportion of babbitted bearings used to-day compared with all other forms is something we cannot know, but it must be so great as to make the number of the others comparatively insignificant.

A Westinghouse Ship Brake.—Mr. George Westinghouse, the inventor of the air brake, is credited with the invention of a brake for ships acting in connection with turbine engines and utilizing a motor which serves to throw the forward thrusting propeller out of operation and to bring into operation a propeller or propellers which give a strong, backward impulse to the vessel. Thus the means causing the forward movement are thrown out of operation and means initiating a rearward movement are brought into play at practically the same time.

Patents and the Department of Agriculture.—At one time the Bureau of Agriculture was a branch of the Patent Office under the charge of the Commissioner of Patents, who reported to Congress statements of the operations of this branch of his office, including the expenditure of the appropriations made for agricultural purposes. Although the Patent Office has advanced and developed in a way gratifying to even its warmest advocates, it still retains its bureaucratic character, while the agricultural branch has grown into an independent department of the Government with a cabinet officer at its head.

Shakespeare and the Bicycle.—The late Col. E. B. Hay was well known throughout the North and East as a handwriting expert and figured in many important trials. He was celebrated as an after dinner speaker, and on one occasion, remarking of the wonders of Shakespeare, asserted that in the writings of the bard you would find a reference to the modern bicycle, and in supporting the assertion, said, "You will remember where in Scene 1 of Act II of the 'Tempest,' Antonio says to Alonso, 'We, too, my lord, will guard your person, while you take your rest, and watch your *safety*.'"

Legal Notes

Early Patent Appeals.—Old patent practitioners recall the period along about 1870 and for six or seven years prior to that time, when appeals from the decisions of the Commissioner of Patents were taken to the individual judges of the Supreme Court of the District of Columbia, including Justices Carter, Fisher, Wylie and Olin. The appellant could take the appeal to any judge he chose, and the appeals were argued in chambers, sometimes at night and sometimes at the residence of the judge. It is said that the appeal fee was payable directly to the judge sitting in the case, and it is sometimes intimated that frequent reversals of the Commissioner's decisions tended to stimulate appeals in certain directions.

Change in Trade Mark Registration Law.—An important change has recently been made in the laws relating to trade-mark registration by an act removing the prohibition against the registration of a mark because it is the name of the applicant or a portion thereof. Heretofore if a corporation whose name, for instance, was "The Acme Shoe Co.," sought to register the word "Acme" as a trade-mark, the application would be refused on the ground that the mark sought to be registered was a part of the name of the applicant. Congress has remedied this in an act approved February 18th, 1911, which contains a provision that nothing in the act "shall prevent the registration of a trade-mark otherwise registrable because of its being the name of the applicant or a portion thereof."

The Rear Axle Patent.—A suit has been entered in the United States Circuit Court for the District of Indiana by Thomas J. Lindsay and Willard Harmon against the Cadillac Automobile Company for alleged infringement of patents held by Lindsay on rear axle construction for motor cars. The patents all cover a revoluble spring seating on an axle housing, and also a method of loading axle construction whereby the drive-shafts of the axles may be withdrawn without disconnecting the axle housing from the car body, and so the differential may be removed without disconnecting the body from the axle housing. Five years ago suit was brought against the National Motor Vehicle Company, of Indianapolis, for infringement of the same patents. The case is still in court, and no decision has been rendered.

A Skirt Decision.—In a recent decision of the United States Court of Appeals for the Third Circuit, the Feuchtwanger patent, No. 662,714, for a skirt consisting of three parts, was held to disclose patentable novelty and invention. The skirt consists of three parts, the lower part being of non-elastic material (jersey), the hip portion of a material having some elasticity, and the waistband of still more elastic material. It is argued that the skirt was a mere aggregation, but the Court held that the improvement was made in a long-developed art in which there was meager sphere for invention. While jersey had been used in jackets and sweaters, it did not occur to anyone before Feuchtwanger to use it, or any expansive material, as a section of skirt.

RECENTLY PATENTED INVENTIONS.

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Electrical Devices.

RECEIVER CASING.—LOUIS STEINBERGER, Brooklyn, N. Y. A receiver casing for telephones constructed according to this invention is much stronger than those usually employed. It cannot roll off of a desk or other surface upon which it may rest, and is not liable to injury or destruction from jarring or knocking due to the swinging of the receiver and the striking of the same against adjoining surfaces.

MOUTHPIECE.—LOUIS STEINBERGER, Brooklyn, N. Y. The invention relates to mouthpieces, and especially to those of the kind used for telephones, and by the aid whereof sounds are to be thrown upon a diaphragm, the more particular purpose being to improve the acoustical properties of the structure, and also to render the mouthpiece more sanitary.

Of Interest to Farmers.

MILK PURIFYING AND HOMOGENIZING MACHINE.—H. H. STÜSSY, Sioux City, Iowa. The object of the invention is to provide a machine, by means of which milk can be rendered stable, and insensitive to souring causes, by means of which impurities can be removed from the milk, and in which the globules of butter-fat are broken up and thoroughly disseminated throughout the milk.

MANGER.—S. W. JAEGER, Bayonne, N. J. This improvement refers to mangers for horses and other draft animals, and has reference more particularly to a device of this class which comprises a movable container for oats or other feed, means for holding the container in an operative, elevated position, and means for removably securing the first means, so that the container can be released to permit it to assume an inoperative position.

POULTRY INSECTICIDE APPLICATOR.—A. F. SHULER, Arcanum, Ohio. This invention provides a reservoir for liquid insecticides, the reservoir having connected therewith a wick or other transferring device for spreading on the head or body of poultry or animals the liquid; and provides a reservoir elongated to cover the maximum space, and having supporting means therefor, whereby the reservoir may be placed in position to discontinue the oil delivered therefrom.

Of General Interest.

SANITARY CUSPIDOR.—JOZSEF PAHOLA, 142 East 19th Street, New York, N. Y. This invention includes a receptacle or casing within which is mounted a glass tray, which is operated by a handle-like actuating device, so as to be turned down or up into position

SANITARY CUSPIDOR.

to permit the contents of the tray to be washed away by the flushes of water by raising and lowering the handle. Thus the cuspidor is thoroughly cleansed immediately after it has been used, and it then closes automatically. By adding to the water some disinfectant the sputum is disinfected and the spread of disease germs is prevented. The apparatus as illustrated, is to be attached to a wall at any desired height and connected with the water pipe. This patent is No. 985,054 and is for sale. Terms obtainable at above address.

CULVERT.—A. H. KAUFMANN, Guthrie, Okla. In the present patent the invention is in corrugated sheet metal culverts and relates particularly to the means for spreading and contracting the same so that they may be conveniently joined together and may be shipped in sections. Means are provided for preventing the nuts from turning so the screw may be manipulated to contract or expand the culvert section as desired.

SAND SCOW.—E. D. CALLEN, Vicksburg, Miss. An object here is to provide a form of scow, by means of which the sand can be more conveniently unloaded than in the ordinary form, which necessitates the use of clam shell buckets, "orange peels" or the like. A further object is to provide a system of suction pipes and valves by means of which the sand may be first mixed with water, and then the mixture of water and sand pumped out.

ANCHORING ATTACHMENT FOR FLOATING BARGES.—J. P. KARR and J. D. RAUCH, Fort Wayne, Ind. This invention pertains to improvements in vertical-speed attachments of floating barges for use in anchoring the latter in shallow water. A spud and spud guide are devised which combine maximum lightness, strength and rigidity; and a spud is provided with a pneumatic attachment, which greatly facilitates the operation of hoisting the same out of the mud.

TRIPLE PURIFICATION WATER STILL.—J. A. POWER, Babylon, N. Y. The object of the present invention is to provide a still arranged to insure a continuous operation, and to subject the water to distinct purification processes, with a view to eliminate volatile gases, sediment and other extraneous matter, at the same time aerating the water to procure a pure, delicious and palatable water at a comparatively low cost.

LIMB REST.—H. BAUERFEIND, Shawano, Wis. This invention is an improvement for rests, particularly such as are used for supporting an arm or leg of a corpse during the process of embalming, and has in view an appliance of this nature adapted to be detachably and firmly clamped at the edge of a table or cooling board, and adjustably held at the required elevation and point of use.

SHEET METAL FRAME.—W. P. LAWRENCE, Colorado Springs, Colo. The improvement is more especially in such frames as are designed to contain glass panels, such as mirrors, windows, doors, pictures, etc.; and has in view a frame which acts to firmly retain the glass without the use of numerous screws, putty, or similar fastenings; also in which the glass is readily removable and replaceable, whereby the renewal of the glass requires but little work or skill.

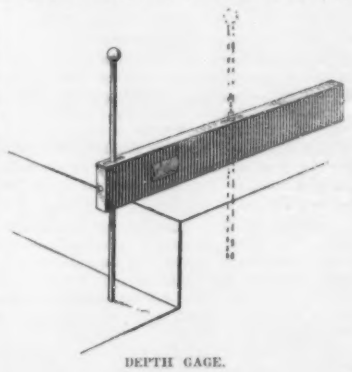
METHOD OF OBTAINING SOLUTIONS OR QUASI SOLUTIONS OF CERTAIN METALLIC OXIDS.—Z. CARTWRIGHT, Ilford, Essex, England. This application relates to a method of obtaining solutions or quasi solutions of oxids of metals contained in the iron group, viz.: iron, manganese and chromium, which are insoluble in water and other media chemically indifferent to the oxids. According to the method forming the subject of the present application, the metallic oxids are suspended in an aqueous solution of a saponaceous material, and thereafter precipitated by the addition of an acid.

FOREGROUND RAY SCREEN.—J. K. HOLBROOK, Newark, N. J. An object here is to provide a device which will retard those rays which act on the sensitized plate or film quickest, and thereby obtain a photograph in which the detail throughout will be just right. The invention has reference to foreground ray screens for use of cameras or other picture-taking devices.

SANITARY VACUUM CHIP REMOVER.—L. S. IRGENS, Oakland, Cal. This improvement pertains to a sanitary vacuum chip remover to be used by dentists for removing the chips from cavities in the teeth during and after drilling with a dental burr. An object of the invention is to provide a remover which may be operated by either compressed air or water, which causes a suction through the apparatus.

Hardware and Tools.

DEPTH GAGE.—JACOB STIRISS, 626 East Jersey Street, Elizabeth, N. J. In the gage illustrated herewith, in clamping either of the blades in adjusted position in either of the keepers, the screw is adjusted so that its end adjacent to the blade will bear thereagainst. In transferring the blade to the other keeper it is only necessary to loosen the screw, to disengage the blade and place the blade in the



DEPTH GAGE.

other keeper, when a further movement of the adjustment screw in the same direction presses the opposite end against the blade. The screw stands in position, so that either of the blades can be entered into either of the keepers without shifting it in either direction. It is unnecessary to transfer the binding screw in changing the blade, and the projection of this screw and nut is obviated from one side of the blade.

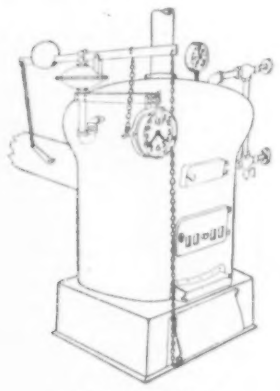
KEY RING.—J. A. PRIDGE, Jr., New York, N. Y. This invention provides a ring, the general outline whereof is circular, the ring being provided with a plurality of separated key-holding compartments and a rigid name-plate for the ring; and provides a compact key-holding device having resilient key-hanging sections, and fixedly secured thereto a plate adapted for use as a name-plate or as an advertising medium.

HAME FASTENER.—J. G. OVERBY, Mellette, S. D. The invention has in view a relatively strong, compact fastener which is readily and easily locked and disengaged, but unlikely to be accidentally released, and which will operate to hold the hame strap close to the collar. It is further constructed so as to be easily applied to hames of the customary type.

COMBINED SQUARE AND RULE.—P. B. OATS, Fort Towson, Okla. An object in this instance is the provision of a device having a rule portion, and a square portion adapted to extend at an angle to the rule portion when the parts are in their extended position, and to be collapsed parallel to the rule portion when the parts are in their folded position.

Heating and Lighting.

FURNACE DRAFT OPERATING APPARATUS.—W. H. SCHUBERT, 4234 Carpenter Avenue, New York, N. Y. The engraving shows an easily attached device to a steam boiler, for opening or closing, at any hour desired, the drafts of a boiler or other heating plant. In addition to saving of labor and the surety of a comfortable house the first thing in the morning, economy in fuel consumption is also claimed. The short chain held by the latch on the clock holds down the forward end of the automatic regulating bar, thus keeping the draft and chimney damper closed until such time as the clock has been set to operate the latch. When the latch releases the chain mentioned, the weight on the bar named causes the drafts to be opened. In a half or three-quarters of an hour, as soon as the radiators are filled with steam, drafts are automatically regulated the same as usual.



FURNACE DRAFT.

Household Utilities.

ELECTRICALLY HEATED OVEN.—F. J. COOK, Collinwood, Ohio. The invention relates to ovens, the more particular purpose being to provide a construction comprising one or more heat-radiating slabs made of stone and especially adapted for receiving and holding the heating wire. It is used for baking, warming and enameling; also in connection with pancake griddles, broilers, toasters, chafing dishes and hot plates.

Machines and Mechanical Devices.

PAPER FEEDING MECHANISM.—T. E. HODGKINSON, 3 Roseberry Avenue, Clerkenwell, London, England. This invention relates to mechanism for printing, folding or the like machines, and more particularly to the type of feeding mechanism comprising a spring arm or arms secured at one end to a shaft and provided at the other end with a frictional pad, so that when the shaft is rotated the pad is brought down on the pile of paper sheets to be fed with more or less force and the sheets are fed forward one at a time.

ROTARY PUMP.—A. FOURNIER, Sprague, Wash. In this patent the inventor's object is the provision of a new and improved rotary pump, designed for pumping purposes and arranged to utilize the driving power to the fullest advantage, with a view to produce a continuous and a forceful stream.

APPARATUS FOR MOLDING BOTTLES.—H. O. BISBING and W. L. SOOY, Coshocton, Ohio. This invention provides a machine with a revoluble molding table having a series of molds thereon; provides a reciprocating head having mounted thereon a blowing pipe and a parting mold for shaping the necks of bottles; and provides means for elevating and depressing the reciprocating head.

POWER TRANSMISSION MECHANISM.—E. S. MORROW and C. M. SIMMONS, Cestos, Okla. This invention relates to automobiles and other power-driven vehicles, and its object is to provide a new and improved power transmission mechanism, more especially designed for driving the front axle, to cause the front wheel to pull when traveling in a straight line or on a curve.

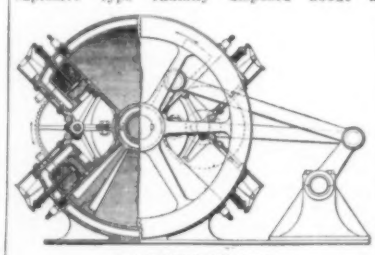
AEROPLANE PROPELLER.—C. M. WANZER, Urbana, Ohio. This invention provides means for reinforcing and mutually supporting the blades; provides a reinforcing structure disposed in straight line arrangement, whereby tensile strength of reinforcing members is utilized; provides means for preventing vibration in the cordage of the reinforcing elements; and provides for securing structure parts of rotary members against centrifugal displacement. It is an improvement on propellers now in use, as they are not capable of giving sufficient impulse at the moment of starting or of applying sufficient power while in flight, as they have not enough wing surface.

INSTRUMENT FOR USE IN NAVIGATION.—O. B. SANDERS, Key West, Fla. By the use of this device the true course is determined, from the compass course in the shortest possible space of time by mechanically allowing for the deviation and variation. The instrument is provided with a plurality of relatively adjustable circular graduations whereby the various deviations and variations may be allowed for.

Prime Movers and Their Accessories.

ROTARY ENGINE.—W. H. RICHMOND, Marquette, Mich. An object of this inventor is the provision of a new and improved engine, arranged to utilize the motive agent to the fullest advantage, by giving the piston an initial impulse by the abutment and a second impulse by the direct pressure of the motive agent.

EXPLOSIVE ENGINE.—CHARLES E. GOODRICH, Daggett, Cal. The invention shown herewith provides a double oscillating piston, producing a continuous reciprocating of a pitman and a rocking shaft connected therewith; provides a plurality of explosion chambers, each operable from both ends thereof; provides a multiple reciprocating motor of explosive type radially disposed about a rotary driving shaft having a flywheel to conform to size of said wheel; provides a plurality of explosion chambers about a driving shaft with a flywheel, the sectors being separated to provide holding spaces for valve mountings and operating mechanism; and provides a multiple explosion motor about the driving shaft with oscillated pistons and translating mechanism for converting reciprocated motion of pistons to a rotary motion of the shaft.



EXPLOSIVE ENGINE.

Railways and Their Accessories.

TRAIN PIPE COUPLING.—D. W. MOSS and C. E. OLSCHNER, Beaumont, Texas. The aim in this improvement is to provide a simple coupling by means of which the pipes may be expeditiously coupled and uncoupled, and which will make a tight and secure joint, that will be unaffected by the relative displacement of the cars with respect to each other incident to ordinary travel.

GUARD RAIL CLAMP.—J. G. WOLFE, New York, N. Y. In this case the object is to provide a clamp arranged to hold the main rail and the guard rail at all times in proper position one relative to the other, and without danger of the rails spreading apart, the clamp being simple and arranged to permit of conveniently placing it in position.

Pertaining to Vehicles.

STEAM BOILER.—J. L. JENSEN, Richfield, and H. DENISON, Manti, Utah. This invention relates to steam traction engines and similar vehicles, and its aim is to provide a boiler arranged to insure at all times proper delivery of dry steam to the engine whistle or other device, and irrespective of whether the boiler is on the level or inclined in either direction on the vehicle going up or down a hill.

RADIATOR SUPPORT FOR AUTOMOBILES.—D. MCR. LIVINGSTON and C. W. FAIRBANK, New York, N. Y. This invention relates to means for supporting the radiator of an automobile and so connecting it to the automobile frame as to permit of a limited movement of one in respect to the other, and thus avoid all unnecessary strain upon the radiator due to the bending, twisting or distorting of the frame.

STEERING GEAR.—G. E. MARQUETTE, Larchwood, Iowa. This improvement pertains to steering gears for traction engines and similar motor driven vehicles or draft devices, and has reference more particularly to a steering gear which is mounted upon a traction engine so that it can be arranged in a plurality of positions to permit the engine to be directed from different points.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

NEW BOOKS, ETC.

THE ART OF CROSS-EXAMINATION. By Francis L. Wellman. New York: The Macmillan Company, 1910. 404 pp. Price net, $2.50.

Although the title of this instructive volume would seem to indicate that it would be of interest only to the reader of legal bent or training, this most assuredly is not the case. The author, himself a master of the difficult art of cross-examination, has discussed this important subject with so much clearness, and with so complete an absence of specifically legal or technical terminology, that even the lay reader without a smattering of the law will find its pages of fascinating interest. Portions of Mr. Wellman's book, particularly those recounting parts of the cross-examination of famous cases, can be read with the lively pleasure one would accord to a thoroughly readable novel. For this second edition Mr. Wellman has practically rewritten his book, so important are the additions, though the first few chapters, as he states in his preface, have been left substantially as they were originally formulated. The chapter on "Cross-examination of Experts" has been rearranged, while chapters have been added on "Cross-examination to the Fallacies of Testimony" and "Cross-examination to Probabilities—Personality of the Examiner," etc. In place of Mr. Choate's cross-examination of Russell Sage in the third trial, the present volume contains the far more amusing and instructive cross-examination of the second trial.

THE GEOLOGY OF BUILDING STONES. By J. Allen Howe, B.Sc., F.G.S. New York: Longmans, Green & Co. 8vo.; 455 pp.; illustrated. $2.50 net.

Students of architecture will find this a very edifying collection of facts relating to the geology of building stones. As it is an English work, naturally it deals particularly with those materials found in the British Isles, only brief reference being made to the stones of other countries. The author has had the advantage of assistance and advice from prominent architects, quarry-owners, and merchants, and has been allowed to reproduce important figures and plates from government bulletins and foreign works.

DROP FORGING, DIE SINKING, AND MACHINE FORMING OF STEEL. By Joseph V. Woodworth. New York: The Norman W. Henley Publishing Company, 1911. 8vo.; 341 pp.

Mr. Woodworth is known as the author of a series of practical books of the working of iron and steel. The volume before us represents a contribution to the literature of a subject on which there is a remarkable scarcity of good publications. The book is written from a thoroughly practical point of view and should prove extremely useful. A striking feature is the profuseness of the illustrations, which number 300 in a volume of 341 pages. Allowing for the index and introduction, this is an average of nearly one illustration for every page. The scope of the book may be indicated from the rather detailed synopsis which appears on the title page. The book is there described as: A Practical Treatise on the Hot and Cold Machine-Forming of Steel and Iron into Finished Shapes; Together with Tools, Dies, and Machinery Involved in the Manufacture of Duplicate Forgings and Interchangeable Hot and Cold Pressed Parts from Bar and Sheet Metal, Comprising Die Sinking and Drop Forging Practice and Design for Modern Forging, Pressing, and Stamping of Duplicate Parts. Die Sinking Methods, Processes, Machines and Tools, Drop Forging Dies; Their Design, Construction, and Use in Drop Hammer and Forging Machine. Press Forming of Heavy Hot and Cold Stock in Dies. Drop Forging and Hardening Plants: Their Design, Fundamental Conditions, and the Equipment Involved in Their Attainment. Steel and Iron: Their Treatment for Twisting, Reducing, Forging, and Working in Drop Dies. Hot Pressed Steel and Iron Parts: Their Manufacture and Assembling into Finished Products. Drop Hammers: Their Development, Use, Weights, Foundations, and Dies. Forging Machine, Steam Hammer, Bulldozer, and Swaging Machine Methods and Processes. Machine Forging, with Examples of Modern Practice and Tools Involved.

POSTER ADVERTISING. By G. H. E. Hawkins. Chicago, 1910. 4to.; 88 pp. Price, $3.

As advertising manager of the N. K. Fairbank Company, Mr. Hawkins should certainly be qualified to speak helpfully and with authority on the subject of poster advertising. The advantages of this manner of crying one's wares, particularly in local advertising, are plainly set forth; the size and cost of posters are considered; and many color reproductions of actual posters are given throughout the work. The writer does not confine himself to the conception and coloring, but goes on to give practical information on checking the service, connecting the advertising with the sales, the cost of posting by States, and general hints to advertiser and poster. Accompanying the reproductions of posters that have become familiar to all of us, are running comments epitomizing their faults and virtues. The official list of Associated Bill Posters is included in the volume.

THE AUTOMOBILE HAND BOOK. By L. Elliot Brookes. Chicago: Frederick J. Drake & Co. 12mo.; 701 pp.; illustrated. Price, $2.

With its alphabetical arrangement of topics and its inclusive scope, this hand book is a veritable encyclopedia for the automobile owner or operator. Its leather covers of red and gold seem to embrace every principle and part of the automobile. Those who have it in one of the earlier editions will be surprised at the amount of new matter that has been added. It embodies all the more recent improvements, and everything connected with automobile construction and operation is explained and illustrated. While the gasoline motor receives, as is its due, the lion's share of the space, yet steam and electric propulsion have by no means been neglected. Transmission, wheel construction, and repair work are each taken up in turn, and plates and sketches are used whenever they are necessary to a clear understanding of the principles under discussion. A chassis plan on a large scale is the subject of one insert, with its thousand-odd parts all numbered and named. With all this abundance of information and suggestion, the volume lives up to its name and just comfortably fits into the hand.

GARAGES AND MOTOR BOAT HOUSES. Compiled by Wm. Phillips Comstock. New York: The William T. Comstock Company, 1911. 4to.; 119 pp. Price, $2.

There is here a large number of pleasing designs by architects from all parts of the country, showing the most recent plans and constructions. The five divisions of the compilation deal with private country and suburban garages; with private city garages; with suburban and city public garages; with motor boat garages and with garage equipment and accessories. As the most modern of structures, the garage presents problems with which architects and draughtsmen generally have had the least experience. There should be absolute protection from fire, an adaptability to the particular need of the particular owner, and convenient arrangement of parts and utilities. Of course the question of gasoline storage is one of prime importance. These points are well covered in the plans given. There are simple structures of low cost. On the other hand, there are buildings of great size and imposing architecture. There is a tiny garage of frame construction with shingled sides and roof, and a few pages beyond we find the elaborate structure, combining features of a castle and a cathedral, owned by George R. Boldt, and situated near Alexandria Bay. The garage regulations of the city of New York are included in the volume.

STATISTICS OF RAILWAYS IN THE UNITED STATES. For the Year Ending June 30, 1909. Prepared by the Bureau of Statistics and Accounts. Washington: Government Printing Office, 1910. 8vo.; 978 pp.

The railroads are much in the public eye of late. Their assets as compared with their issued securities, their earnings as compared with their expenses, their right to raise rates, to reduce wages, to influence legislation, are topics of common discussion. While it is claimed that the ordinary financial statement is "all things to all men," yet the knack of intelligently reading such a statement is not hard to acquire, and, once acquired, is always illuminating and instructive. The various divisions of the twenty-second annual report will interest widely divergent classes of readers—railway mileage, the man who follows his country's progress; statistics of employees, the employee and the labor union; profit and loss statements, the investor; accidents, the student of modern risks in occupation and in travel.

DYKE'S AUTOMOBILE ENCYCLOPEDIA. By A. L. Dyke, E.E. St. Louis: A. L. Dyke, 1911. 8vo.; 407 pp. Price, $3.

There are so many treatises of this nature, each one claiming some advantage over the others in arrangement or manner of expression, that it is becoming increasingly difficult to fairly appraise their qualities or to justly commend one above the rest. Here we have twenty-nine lessons, positively packed with diagrams and illustrations. We are told how to choose, drive, and maintain a car. Every point of construction and operation that it is necessary or advisable for owner or chauffeur to know is here given in the simplest language. One lesson is devoted to the rules of the road, the State laws, etc. These latter give the registration fee, the allowed speed, and the required lamps. Another lesson covers the aeroplane and aerial engines. A chapter is given over to a discussion on building a home workshop, a garage, and the overhauling of old cars. The final section is a dictionary of motor words and terms. We must accord a word of praise to the way in which the illustrations have been shorn of all intricacy, showing only just what is necessary to the understanding of the question in hand. As a reference book, this should prove an acquisition to the motorist's library.

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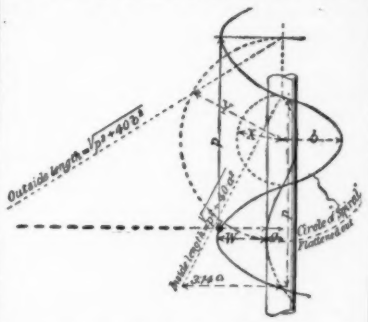
J. M. J. Your attention is called to the statement regularly printed at the head of our Query column, "No attention is paid to unsigned queries."

(12436) J. M. W. says: I wish to work a spiral out of tin, the planes of which are to be 6 or 8 inches wide, wound round a ¼-inch cylinder; the turns of the spiral to be 4 or 6 inches apart. Will you please tell me how to do this? A. You need to know the length of two spirals, one the inside edge and the other the outside edge of the blade of the helix. Let a be the inside radius and b the outside radius of the spiral, and p the pitch. Then the inside edge length is $\sqrt{p^2 + 40\ a^2}$ and the outside edge length is $\sqrt{p^2 + 40\ b^2}$. If W is the width of the blade, $b - a = W$. Now the segment of sheet metal which makes the blade must have radii longer than those of finished spiral, so that it will



"curl up" close around the shaft when pulled into the desired shape. Let X and Y be the respective radii. Then $\frac{X}{Y} = \frac{\sqrt{p^2 + 40\ a^2}}{\sqrt{p^2 + 40\ b^2}}$

As $Y - X = W$ as before, $Y = W + X$, and substituting, $\frac{X}{W + X} = \frac{\sqrt{p^2 + 40\ a^2}}{\sqrt{p^2 + 40\ b^2}}$. Now you know a, the inside radius of the shaft on which the spiral is wound, which you say to be ⅛ inch, and p, the pitch of the spiral, which you say is to be 4 inches to 6 inches, and you know W, which is to be 6 inches to 8 inches. Decide what exact figures you want, substitute the values of a, b, and W, and p, and solve for X, which will give you the radius you want.

Note that $3.14^2 = 10$ (very nearly) and that the outside curve of the piece of metal which will be curled up to form the helix or spiral is equal in length to the line $\sqrt{p^2 + 40\ b^2}$ which is the outside of spiral *unrolled*; the inside curve is also equal to the line $\sqrt{p^2 + 40\ a^2}$; and these two circular arcs are to each other as $\sqrt{p^2 + 40\ b^2}$ is to $\sqrt{p^2 + 40\ a^2}$, and their radii X and Y have the same ratio, while $Y = X + W$.

(12437) J. B. F. says: The star Venus which sets about 7 P. M. seems to have a distinct oscillating or "floating" motion which has been commented upon by a great many of the daily papers. A. The scintillation or twinkling of Venus is not a rare phenomenon, but is noticed when the planet is near the sun in the early twilight, and when the atmosphere is much disturbed. On clear cold winter nights all the bright stars may show much the same appearance. We have had many letters from the South about this matter this winter. Some have declared that the planet was a new star moving so rapidly about that it left a trail of sparks behind it as it went.

(12438) C. C. says: Will you please send me copy of your paper which tells how to recharge dry batteries, as I remember seeing it in one of them? A. You will find in SUPPLEMENTS 1383 and 1387, price ten cents each, full details for making dry cells. There is no good way to recharge old dry cells. They are not worth the labor and cost, but are universally thrown into the waste heap. Some have got a little more service out of them by punching the case full of holes and setting the cell into a jar of dilute sulphuric acid, or better of sal ammoniac solution. Each cell must have a separate jar, thus making the battery an ordinary wet battery. Others have got a little life by digging out the pitch from the top and soaking the cell in a sal ammoniac solution. But all these modes give small return, and if time is of any value, they cost more than they come to.

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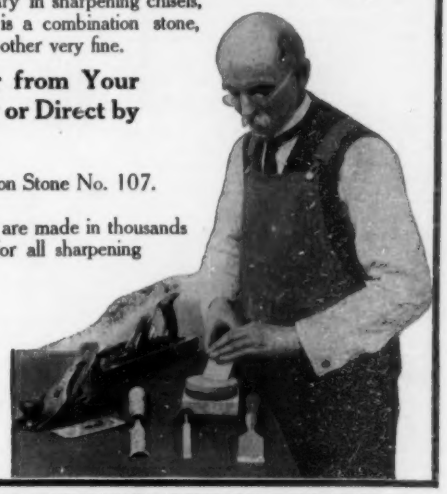

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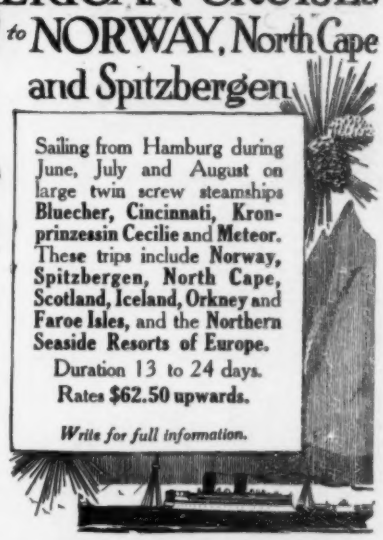

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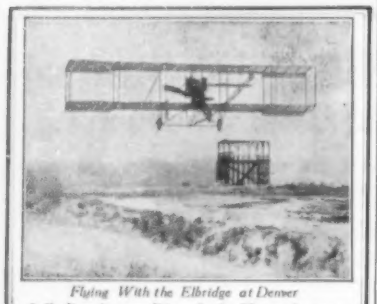

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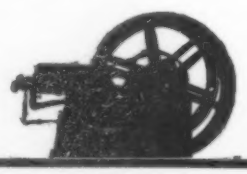

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Battleship versus Destroyer

(Continued from page 406.)

pany. The tests of this weapon have shown it to possess slightly greater accuracy and far greater penetrating power at distant ranges than the present 12-inch gun. The weight of the shell has gone up from 850 pounds in the 12-inch to nearly 1,400 pounds in the 14-inch, and though the muzzle velocity is less, the muzzle energy is far greater, and the falling off in the energy at long range is very much less.

Just what the introduction of this gun means in the "New York" and "Texas" will be understood when we state that its projectile will be capable of penetrating the armor of any battleship afloat at any range at which the hulls of the ships are visible. Moreover, to such a high pitch of accuracy has gunnery been carried in our navy that at these extreme ranges the majority of the shots will get home.

In clear weather the torpedo battleship, then, will be under fire at a range of nine miles. Its speed of, say, 24 knots, would enable it to get within torpedo range in a running fight within a couple of hours, if the chase started, say, at a nine-mile range. It can readily be seen that the problem of putting sufficient protective armor on the vessel to enable it to stand up against the 14-inch gun during a chase of that duration, would be a very difficult one to solve. The general dimensions and leading features of the "New York" and "Texas" are as follows:

Length on water line, 565 feet; extreme breadth, 95 feet, 2¾ inches; trial displacement, 27,000 tons; trial draft 28½ feet; total coal bunker capacity, about 2,850 tons; coal and fuel oil carried on trial, 2,167 tons; speed on trial, minimum, 21 knots. The armament will consist of ten 14-inch, 45-caliber rifles and four submerged torpedo tubes in the main battery, and in the secondary battery twenty-one 5-inch rapid-fire guns; there will also be four 3-pounder guns for saluting, two 1-pounder guns for boats, two 3-inch field pieces, and two 30-caliber machine guns. The armor plan has not been published, but it will be unusually complete. The ships are to be finished in about thirty-three months from the present date.

A DESTROYER OF BATTLESHIP SIZE.

BY R. G. SKERRETT.

At the close of the war between Russia and Japan the technical press was filled with much conflicting material regarding the relative military merits of the torpedo in actual conflict. There is no doubt that the torpedo during that period of hostilities gave evidence of widley varied effectiveness—in some cases the damage was undoubtedly disastrous, while in others the amount of injury was astonishingly small. The different ranges at which the torpedoes were fired and the manner in which they struck their targets had much to do with the results, just as we should expect of any projectile fired from a gun; and we must not forget that the torpedo, in a sense, is also a projectile, and cannot be expected to function uniformly under all possible circumstances of service. However, to dispel some of the doubts arising from the conflicting reports of the action of the torpedo in the Russo-Japanese war, Italy undertook to determine at first hand some of these questions by means of experimental firings against one of her old battleships. For this service the "Francesco Morosini" was especially prepared at considerable expense, special cofferdams being arranged in order to limit the area of possible damage as well as to typify defensive developments capable of further minimizing the destructive powers of the torpedo. In order to carry out the simulation of actual attack as far as possible, a regular service torpedo was held against the side of the ship by means of a framework fastened about three meters below the waterline, and the nose of the torpedo was set at right angles to the skin of the vessel.

The Italian authorities counted upon making a number of experiments with the "Morosini," but the first explosion was enough to send the ship forthwith to the bottom. Divers sent down to examine the vessel reported a damaged area of about fifty square meters, which, while easily explaining the promptness with which the vessel sank, was a great surprise to the officials.

Immediately after the "Morosini" test it was authoritatively announced by both the Austrian and the British technical press that the direct result of the experiment would be the introduction of a new, speedy type of vessel, whose principal armament would be torpedo launching tubes—the craft to carry many more of these than any other ship extant. In fulfillment of this prophecy we are now able to publish an account of a fighting ship of this description based upon data and details coming from abroad. The design of this vessel seems to have been worked out with ingenious thoroughness, and certainly a novel and very formidable type is thus promised for the fighting fleet of the immediate future.

During the past ten years experimental work has revolutionized the military efficiency of the automobile torpedo; the weapon is now capable of carrying a larger destructive charge and is able to run farther and to hold its course with a remarkable degree of precision and speed. While the modern battleship may survive the blow of a single torpedo, still enough damage would, in all likelihood, result to render the ship incapable of holding her position in the line or maintaining the fight under conditions of equal efficiency. Should the torpedo explode under either the boiler or magazine spaces, one blow might be enough either to destroy the ship or to render her completely *hors de combat.* No single shot from the biggest of modern guns could reach these same vitals under normal conditions; hence we see wherein lies the destructive superiority of the torpedo.

Rear-Admiral R. H. S. Bacon of the British Navy has said that the battleship of the future will be designed exclusively for combating other battleships, and that intermediate heavy craft would disappear and the link between the ocean-going destroyer and the battleship would become closer—the sea-going torpedo craft acting as defensive and offensive satellites for the heavier and less speedy vessel. It is instructive to recall that up to the present no existing torpedo craft are capable of truly fulfilling Admiral Bacon's prophecy; none of these vessels is big enough to take the sea and to hold her own with the battleship under those more trying conditions of wind and sea in which the modern dreadnought is capable of calling an enemy to account.

Everyone knows that the battleship is merely a mobile, armored platform for the proper carriage and transport of the heavy ordnance which constitutes its prime means of offense. The biggest of our 12-inch rifles at present afloat fires an armor-piercing projectile weighing 870 pounds, carrying an explosive charge of about 3 per cent of this weight. In order to accomplish its purpose, the armor-piercing shell must perforate the defensive plate and remain intact, so that it may burst with maximum violence after it has passed through the protecting armor. The modern automobile torpedo has a bursting charge of gun-cotton of more than 200 pounds in weight, and this explosive, per unit of weight, is several times more destructively violent when properly detonated than the explosive or bursting charge with which our armor-piercing projectiles are loaded. The torpedo reaches an enemy below the waterline, and where least prepared to resist a violent blow—in fact, in the very region of the ship's "vitals"—and yet up to now the torpedo has not been properly recognized and put aboard of craft really capable of placing this military instrument efficiently and effectively in touch with the foe under all probable fighting conditions. From a purely destructive point of view it is plain that the torpedo is a much more potent agent for doing damage than a number of the biggest 12-inch projectiles, and, after all, the object is to either stun or to annihilate the foe, and thus we see the reason for being of this modern evolution, the torpedo battleship.

The torpedo battleship, to fulfill her mission, must be capable of withstanding pretty heavy retaliatory blows—in other words, she must be able to stand up against a defense which would wither the attack of a group of unarmored torpedo boats. Her aim is to eat her way,

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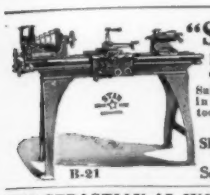

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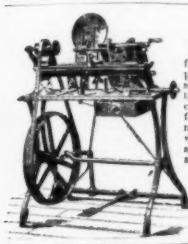

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so to speak, in the face of a storm of rapid-fire projectiles, until within certain striking distance of her quarry. The vessel herewith shown is amply assured of this power of resistance, because her waterline and broadside throughout the greater part of her midship length are shielded by armor plate ranging from six to twelve inches in thickness, while the waterline region forward and abaft of this area is also covered with protecting armor and cellulose, so as to safeguard the ship against attack which might impair her stability. In addition to this, she has three protective decks and the under-water body is defended by a double bottom, athwartship bulkheads of heavy plating, and also light vertical and horizontal armor plating throughout the region of the torpedo tubes, and the boiler and engine spaces, as indicated in the accompanying diagram. This, in itself, is something of a departure, and is purposely designed to render this vessel less vulnerable to the attack of other torpedo craft.

The proposed ship has the following principal characteristics and general dimensions: Displacement, 15,250 tons; length over all, 492 feet; maximum beam, 75.5 feet; draft, 25.5 feet; motive power, turbines, total capacity 36,000 indicated horse-power; speed, per hour, 24 knots; radius of action, at 18 knots per hour, 2,000 knots.

The armament is to consist of the following elements: Thirty under-water torpedo tubes for the discharge of the long 18-inch Whitehead torpedoes; twenty 4.7-inch quick-firing guns in individual turrets; two 4.7-inch quick-firing guns in casemates, forward on the main deck; ten 2.25-inch quick-firing guns, distributed forward and aft on the bridges.

The ship will carry a supply of sixty automobile torpedoes, and, unlike the deck tubes of the ordinary torpedo boat, these tubes can be reloaded with perfect security while the ship is actually attacking the enemy, if it be necessary. Certainly a ship of this sort opens up a new and fascinating vista in the evolution of the fighting craft.

The Gordon Bennett International Aviation Trophy

(*Continued from page 407.*)

elimination race will no doubt be of interest at this time.

The wonderful French production, the Gnome rotating motor, will undoubtedly be used, to the exclusion of all other makes, by the French team. Whether this motor has the qualities of endurance possessed by the older reciprocating engine is a matter open to discussion; but the performances of the past season have shown pretty conclusively that as a racing motor the Gnome is in a class by itself. It holds all of the world's aviation speed records to-day.

Until this year the 50 horse-power seven-cylinder Gnome motor has been the engine used in what we might call the touring aeroplane, while only a very limited number of the 100 horse-power type have been made, and these were used only for racing purposes. The 100 horse-power motor is practically two 50 horse-power engines in tandem, a common crank case being used.

For the year of 1911 the Gnome Company is turning out, in addition to its former models, a seven-cylinder engine of 70 horse-power and a fourteen-cylinder monster rated at 140 horse-power. The stroke of these new motors remains the same as in the previous models, the extra power being obtained by enlarging the bore. Minor changes have also been made in the structural details, principally with a view of making the motor more readily mountable.

Of the aeroplanes which will compete in the French elimination for the Gordon Bennett race, that of the veteran builder Blériot of course stands out prominently. The new machine, which has been designed and built especially for this contest, is technically called the "Model Twenty," but from its first appearance it has been familiarly referred to as the "Fish Tail" Blériot, because of the resemblance of its tail and rudder to the tail and upper rear fin of a fish.

By far the most interesting feature of the new "Model Twenty" is the use of a flexible trailing edge on the wings, the construction being almost identical with that used by Henry Farbre in the biplane bearing Paulhan's name.

The entering wedge of the wings is quite different from that formerly employed by Blériot, and, indeed, unlike that of any other machine. Monoplane makers up to the present time have followed pretty closely what is technically called the "Phillips section" in the construction of their wings, as shown in Fig. 1.

Blériot, in his new "fish tail" monoplane, has made a radical departure from the orthodox design, the entering wedge having a decided and peculiarly shaped "hump," as shown in Fig. 2, at *a*. This figure also gives an idea of the flexible trailing edge. The entering edge of the wings and that portion up to *b* in Fig. 2 is rigid, except for the slight movement allowed for "warping." From *b* to *c* there are tapering flexible ribs sunk into the rigid portion of the wings, and separated from each other by a distance of about one foot. The whole framework is covered, as is customary, with cloth, the cloth stretched between the flexible ribs giving the wings a bat-like appearance.

Fig. 1.—Phillips section curve generally used.

The "fuselage," or body of the "Model Twenty" Blériot, is, unlike the former types, entirely inclosed, cloth being tightly laced over a framework similar to, but about half the depth of, the standard Blériot fuselage. The tail plane and elevator are flat instead of curved, and the rudders are two triangular planes above and below the flat tail plane.

Fig. 2.—Cross-section of new Bleriot monoplane wing.

The peculiar blunt shape of the heavy front edge is shown at A, and the flexible rear edge from B to C.

The writer was present at the Blériot school at Pau, France, when the first "Model Twenty" was tested. Driven by a Gnome 50 horse-power motor, it passed the regular model with the same engine at a speed approximately 20 per cent greater. Evidently Blériot himself was pleased with his new design; for the Gordon Bennett racer is the "Model Twenty" fitted with the new 140 horse-power Gnome motor.

Another monoplane which has attracted some attention lately, and will probably be heard from in the French elimination race, is the "Derpedussin," designed by a Frenchman of that name. This machine has some points in common with both the Blériot and Antoinette. The "Derpedussin" first came prominently into the limelight when Busson, a couple of months ago, at Rheims, broke the world's speed records carrying two passengers. One of the 140 horse-power Gnome motors, now being built, is for the "Derpedussin" monoplane intended for the Gordon Bennett elimination.

A machine almost identical with the Blériot in general appearance is the Morane, designed by Leon Morane, a former Blériot pilot of note. The Morane monoplane differs from the Blériot principally in the landing chassis and tail planes. From the above one can see that it should be a factor in the French trials.

Aviation experts were indeed surprised when the little Nieuport monoplane, driven by an opposed double-cylinder motor of only 30 horse-power, practically equalled Leblanc's fastest records established at Belmont Park last November with his Gordon Bennett 100 horse-power Gnome Blériot. A careful examination of the Nieuport shows nothing unusual in wing design which could account for the remarkable speed developed with such a low-power engine; but even a casual glance at the body construction and the miniature and rather impractical-looking landing chassis, does much to explain the mystery. Unquestionably its phenomenal speed is due to the reduction of head resistance The fuselage

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follows the "stream-line" form more nearly than that of any other machine, being comparatively blunt at the bow and tapering gradually to the tail. It is the opinion of the writer that few designers to-day realize the enormous importance of reducing head resistance in a racing aeroplane, or, for that matter, in any type of *machine á voler.*

In speaking of the racing machines which are likely to figure prominently in the French trials for the Gordon Bennett trophy, one cannot neglect mentioning the Breguet biplane, which holds the world's record for weight lifting. Only a few weeks ago this remarkable machine flew a short distance at Douai, in France, with no less than twelve persons aboard, and also showed truly remarkable speed for a biplane. It is safe to say that, outside of the Wright "Baby Grand," which has been somewhat of a "dark horse," the Breguet is by far the fastest biplane in the world. And in Breguet the world has another designer who appreciates the advantage of keeping down head resistance. In his new biplane most of the wire stays and small struts common to biplanes have been eliminated, and large frame members, of fewer number and having a "stream-line" form, have been substituted. The fuselage, too, is inclosed and of small section, tapering gracefully to the tail planes.

It certainly looks, just now, as if the French will be well-nigh invincible in the Gordon Bennett race. Unquestionably the French lead the world to-day in aviation. French makers are carefully guarding their new models, and will not place them on the market until after the Gordon Bennett contest. Both England and America will have difficulty in choosing a team of three fast machines to carry their respective colors, while the French have a great variety from which to choose. This fact, combined with the fact that the pick of the new 140 horse-power Gnome motors will doubtless be assigned to the French racers, gives the French a decided advantage in the forthcoming contest.

Armored Cars in the Mexican Revolution

(Continued from page 410.)

tected, but the steel apron extends down over the drivers and trucks, back over the sides of the water tank, and up around the smokestack, coming back in a straight line to the cab, so as to protect the domes as well.

The main use of this engine and the armored cars will be to patrol the Mexican Central branch of the National Railways on that division which extends from the border at Juarez (opposite El Paso) to Chihuahua, a piece of railroad which has been in the hands of the rebels for some months. The government believes that, with these cars, it will be able to prevent further dynamiting of bridges and tearing up of tracks by the insurrectos, at least along this particular line.

Lakes Tipped by Winds

UNDER the force of great gales, large lakes and tideless seas, like the Caspian, have been observed to experience surprising changes of level, as if they were huge basins of water tipped by the hand of a giant.

In the Caspian a difference of level between the two sides of the sea amounting to twelve feet has been noted during the prevalence of a heavy wind. In Lake Erie a difference of level of fifteen feet has occurred in similar circumstances. Analogous observations have been made on other lakes and in the Baltic Sea.

A Dam of Buttressed Arches.—A form of dam with buttressed arches in place of a gravity mass is outlined in a study in *The Engineer* by Reginald Ryves. The proposed structure has an up-stream face placed at an angle of 45 degrees, and varying in thickness from 17 feet at the base to 6 feet at the crest. The rear face presents a series of arches, turned up stream, with their abutments supported by a series of buttresses, which bed upon the carefully prepared surface of the solid rock. The maximum stress on the arches is 12 tons, and on the buttresses 10 tons per square foot.

Aeronautics

Four Persons in a Record Cross Country Flight.—That the prophecy made on page 407 regarding the immediate use of the aeroplane for cross-country flights with several people, is already being fulfilled, is shown by the record flight on the 14th inst. of Aviator Lanser from Kiewit to Brussels—a distance of 54 miles—with his three sisters.

Aviation at Mineola.—Last week W. Starling Burgess made some flights in a Wright-type biplane of his own construction, at Mineola. He has learned to fly a Wright machine and is manufacturing them under license, as well as Farman-type biplanes, of which he has already made seven for Grahame-White. Mr. Burgess has opened an aviation school at Mineola, and a number of pupils have already been enrolled.

Unsuccessful Test of a Novel Aeroplane.—The first test of the novel dish-shaped aeroplane of W. S. Romme, the model of which showed excellent automatic stability, occurred on April 14th at San Antonio, Texas. Although fitted with a Gnome motor of 50 horse-power, the machine was unable to get off the ground, according to the telegraphic report. It is said to have been rather badly damaged by jolting over the ground. Mr. Harold McCormick, of Chicago, has assisted in the developing of this machine.

A Novel Two-motor Aeroplane.—One of the would-be entrants for the Gould two-motor aeroplane prize is Mr. Julius W. Schubert, a young Austrian of considerable mechanical ability, who has invented and patented a novel biplane and motor with a view to competing. The usual devices for maintaining the transverse balance of the aeroplane are dispensed with in this biplane, two double-surface horizontal rudders—one toward each side and in front—being used instead. The motor is in three units, two of which are run together and made to drive two propellers in front, while the other unit drives a single propeller at the rear. Mr. Schubert would like to hear from anyone willing to help him in the construction of a machine with which to compete for the Gould prize.

Perilous Flight with a Lady Passenger in America.—Frank Coffyn, one of the Wright aviators, made a 17-mile flight from Augusta to Aiken, S. C., in 21 minutes on March 30th. He was accompanied by his wife, who was thus the first lady passenger to make a cross-country flight of any considerable distance in the United States. This flight was made in a strong wind. It was an excellent demonstration of the already well-known capabilities of the Wright machine. The speed average was about 50 miles an hour.

An Astonishing Flight from London to Paris.—Not since the late John B. Moisant flew from Paris to London with a passenger has anything so sensational been accomplished in this direction as was the non-stop flight of M. Pierre Prier on Thursday, April 6th. In a Blériot monoplane of 50 horse-power, M. Prier covered the distance of about 250 miles in 236 minutes, or in less than four hours, thus averaging more than 63 miles an hour throughout the entire distance. The start was made from Hendon, near London, at 1:37 P. M., and the finish was at Issy les Moulineaux at 5:33. Both at the start and at the finish the aviator ran into a thick fog and he was obliged to ascend to the height of 3,200 feet in order to get above it. He crossed the Channel at this height, which he kept throughout most of his journey. At Beauvais, about 50 miles from Paris, he entered the fog a second time, after having a clear atmosphere during the intermediate stage of his journey. The monoplane he used is said to be the same Blériot with which Le Blanc won the Circuit de l'Est last summer. The fastest express trains from New York to Boston, which is about the same distance as from London to Paris, require five hours in which to make the journey, so that M. Prier's feat is remarkable not only for the long distance across country and over the Channel in a single flight, but it is also noteworthy on account of the high average speed he maintained. The possibilities of the aeroplane for rapid communication have never been more brilliantly illustrated.

Interesting Books

The Scientific American Boy

By A. RUSSELL BOND, 12 mo., 317 pages, 340 illustrations. Price, $2.00.

¶ This is a fascinating story of outdoor boy life, and contains a large number of practical suggestions which, in addition to affording amusement, will stimulate in boys the creative spirit. In each instance complete practical instructions are given for building the various articles. The boy camper is supplied with directions for making tramping outfits, sleeping bags, tents, tree houses, straw huts, log cabins and caves. Winter diversions include instructions for making skate sails, snow shoes, ice boats, scooters, sledges, toboggans, etc. The more instructive subjects covered are surveying, wigwagging, heliographing and bridge building. Miscellaneous devices, such as scows, canoes, land yachts, windmills, water wheels and the like are also described. It is attractively illustrated with half tones from life and numerous diagrams and engravings drawn to scale.

The Scientific American Boy at School

By A. RUSSELL BOND, 12 mo., 338 pages, 314 illustrations. Price, $2.00.

¶ This is a sequel to "The Scientific American Boy" and like its predecessor is brim full of practical suggestions, all of which are entirely new. The construction of the apparatus, which is within the scope of the average boy, is fully described and the instructions are interwoven in a fascinating story, which makes the book interesting as well as instructive to the boy. This volume contains instructions on surveying, sounding and signalling, the building of dams, canals and canal locks, truss bridges and several different types of boats. Sun dials, clepsydras, seismographs, gliding machines, kite photography and camera hunting are a few of the other interesting subjects taken up. Other unique ideas are water kites, fish-tail boat-propellers, bicycle sleds, geyser fountains, etc. No boy of a mechanical turn of mind can read the story without being inspired to try his hand at making the devices.

Magic, Stage Illusions and Scientific Diversions, Including Trick Photography

Compiled and Edited by ALBERT A. HOPKINS. Large octavo, 556 pages, 400 illustrations. Price, $2.50.

¶ This work appeals to old and young alike, and is acknowledged by the profession to be the standard works on magic. The illusions are all explained in detail, which show exactly how the tricks are performed. Great attention is paid to the exposes of large and important illusions, which in many cases have been furnished by the prestidigitateurs themselves. Some of the most important tricks of Robert Houden, Bautier de Kolta, Heller and Hermann are explained. Conjuring tricks have not been neglected, a selection of some of the best of them having been made—fire-eaters, sword-swallowers, ventriloquists, shadowgraphists—all come in for a share of attention, while mental magic, ancient magic, trick photography, automata, curious toys and stage effects are well described and illustrated.

The New Agriculture

By T. BYARD COLLINS, 12 mo., 374 pages, 106 illustrations. Price, $2.00

¶ This interesting volume is a popular outline of the many changes which are revolutionizing the methods of farming and the habits of farm life. It deals with the subject in a scientific way and form a new viewpoint. The author has devoted his lifetime to the study of changing economic agricultural conditions. Irrigation, the new fertilization, the new transportation, the new creations, the new machinery, all come in for a share of attention. The illustrations are of special value, and are unique. All who are interested in agriculture should obtain a copy of this most timely addition to the literature of agriculture.

The Fourth Dimension Simply Explained

With an Introduction and Editorial Notes by PROF. HENRY P. MANNING. 12 mo., 251 pages, illustrated. Price, $1.50

¶ A friend of the Scientific American donated a prize of $500 for the best simply-worded non-mathematical explanation of the fourth dimension. The prize essay, together with the three others, which were accorded honorable mention, were published in the columns of the Scientific American. As a result, so much interest was aroused on the subject of the fourth dimension, that it seemed advisable to collect, in permanent form, the more meritorious of the 245 essays which were sent in from all parts of the world. The present work presents twenty points of view, all of them intereresting and no two quite alike. The reading of one essay does not involve the reading of the entire work, yet the entire book gives a comprehensive view of what the layman wishes to know about the fourth dimension.

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Length of the Stride.—It has been estimated that the average length of a man's stride is 31½ inches, and that the distance an average traveler can cover at this rate is 7,158 yards an hour, or 119 yards a minute. The number of strides would be 7,500 an hour, or 125 a minute. The length of the stride in the various armies is as follows: United States, 30 inches; German, 31½ inches; Austrian, 29½; Italian, 29½; French, 29½; British, 30 inches.

Wonderful Effects of Forests.—A striking example of the transforming effect of forests, not only on the appearance, but on the productivity of a country, is afforded by the department of the Landes in France. At the close of the eighteenth century about 2,500,000 acres in that region were little more than shifting sand-dunes and disease-breeding marshes. At the present time the same lands are among the richest, most productive and healthful in all France, and the change has been brought about by intelligent cultivation of pine forests. Even the character of the climate of the region has been ameliorated, and it has become mild and balmy. A thin layer of clay beneath the sandy upper surface of the soil, formerly impervious to water, has been pierced by the pine roots, until a thorough drainage is established to the spongy earth that lies below.

Postglacial Climate.—In a sumptuous quarto volume of 500 pages the Executive Committee of the Eleventh International Geological Congress has published a series of 47 memoirs discussing the evidences of postglacial changes of climate in 23 countries. As the contributors to the volume include the leading authorities, in each country concerned, on this complex question, the work may be regarded as summing up all that is known—and a great deal that is conjectured—regarding the later stages in the history of geological climate. It must be admitted that the information contained in the book is bewilderingly heterogeneous and conflicting, and the average reader is not likely to penetrate beyond the masterly summary and review, from the pen of Gunnar Andersson, which constitutes the introduction; but as a unique book of reference the work is so important that no large scientific library can afford to be without it. We regret to notice that France has contributed nothing to this noteworthy international publication. The contributors to the United States section are Wm. C. Alden, Wm. H. Dall, F. H. Knowlton and O. P. Hay.

Five New Variable Stars.—A circular has been received from Harvard College Observatory in which it is stated that Miss Cannon has continued her examination of photographs forming the map of the sky, and this has resulted in the discovery of Nova Sagittarii, No. 4, two new variable stars in Map No. 43, and three new variable stars in other regions. Nova Sagittarii, No. 4, was visible at its greatest observed brightness on May 22nd, 1901, but was not seen on a photograph taken April 10th, 1901, which shows the adjacent star of magnitude 14, slightly south of the position of the Nova. The fluctuations in brightness appear to be somewhat similar to those of Nova Persei, No. 2, during its so-called oscillatory period, from March to June, 1901. Prof. Pickering calls attention in the circular to the fact that seven new stars are known to have appeared in the Harvard Map of the Sky. The first was Nova Ophiuchi, No. 1, 172,421, Kepler's new star of 1604, which rivaled Venus in brilliancy. Nova Ophiuchi, No. 2, 165,312, appeared in 1848, and Nova Sagittarii, No. 1, 185,613, in 1898, both of these being on the extreme edge of Map No. 43. Nova Sagittarii, No. 3, 181,325, appeared in 1899, Nova Sagittarii, No. 4, 180,027, in 1901, Nova Scorpii, No. 2, 174,734 b, in 1906, and Nova Sagittarii, No. 2, 175,427, in 1910.

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The ANNUAL SMALL HOUSE NUMBER *of*

AMERICAN HOMES *and* GARDENS

The May number of American Homes and Gardens will be devoted to the small house, its building, its decoration and its furnishings. This issue will contain a vast amount of information for the prospective home builder. Special attention will be given to the inexpensive small house, the type which at once excites interest and offers the richest field for helpful suggestions. Various departments, conducted by specialists, add greatly to the value of this number, and the aim has been to bring out the charm of the simple, beautiful things which contribute to domestic comfort and happiness solely for the purpose of solving the problems which confront the householder and which cannot be explained without the assistance of an expert. Besides these departments the magazine will contain a host of articles which must stimulate the desire for home improvement.

Contents for May, 1911

The Small House of To-day
Flower Arrangements for the Table.
Salad at any Time of the Year
Designing a Bilateral Stencil
Home-Built, Ornamental Flower Urn
A Bungalow Made of Terra-Cotta Blocks
The Modern Kitchen
Dark Blue Staffordshire
Bungalows of Interesting Type
Decorative Curtain Schemes
New Breeds of Goats
The Motor Car for the Man of Moderate Means
The Inexpensive Small Garage
Two New England Houses
Spraying the Apple Orchard
Planning a Seashore Garden
Planning Small Country Places
A Garden Miniature Arbor
Consider the Lilies
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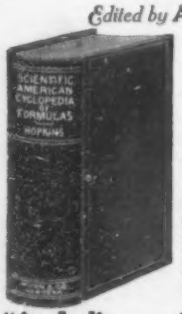

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